CHEMISTRY

50¢

How the Leaf Works

➤ THE SOLUTION of one of the major mysteries may come before long: How the green leaf captures the energy of sunshine and stores it up in the making of food.

This great problem once solved should lead to "artificial photosynthesis," that is, doing what the plant does without the aid of life.

Potentially this can mean: a vast increase in the food or raw material supply; a revolution or a virtual substitution for agriculture.

Factories can be located in tropic or desert areas, powered by sunshine. Civilization can be relocated in parts of the world removed from the present power sources of coal, oil and water power.

This is a bigger accomplishment than the release of atomic energy, although it does not seem capable of being used as a weapon.

Man has long envied the green leaf its ability to use sunlight to power its miniature chemical factory.

Chemists have investigated many processes carried out by living tissues and found that, one after another, they have proved to happen according to natural laws. No particular need for a living force, such as used to be imagined, has been found once the conditions for the reaction have been fully understood. Therefore, they have believed that the final great secret of photosynthesis would one day be found. Once found, they are sure it can be used by man-built factories to produce food and materials beyond the capacity of today's farms and gardens.

Early chemists, such as Liebig, Baeyer, Willstatter and Stoll, studied the problem of how the plant makes starch and sugar. They succeeded in learning that the plant needs water and carbon dioxide as materials to build its chemicals, and that it requires sunlight to carry out this reaction.

Today's chemists and physicists, aided by radioactive atoms and the newer knowledge of energy, are working out step by step the reactions in the leaf which use the sun's energy in chemical synthesis.

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▸ SPLIT-SECOND *timing governs the study of reactions in the light and in the dark when scientists seek the whole story of how plants carry on their photosynthetic reactions. This apparatus was photographed at the National Institutes of Health, Bethesda, Md.*

Photosynthesis Soon

by HELEN M. DAVIS

▸ FINAL STEPS in understanding the mystery of photosynthesis seem near. As research workers concentrate on the three chemical reactions carried on by green plants with the aid of sunshine, each new discovery narrows the gap between what is already known and the ultimate day when man can set up his own photosynthetic system in competition with nature's.

When that day comes, cloudless desert country will become the favored location for factories powered by sunlight. Civilization will no longer be bound to deposits of coal and oil, or sites where water power can be developed. Crops will be grown under

optimum conditions, and may possibly consist of plants completely different from those we now depend on. Life will be different, but there is no need to believe that it will be less enjoyable.

Instead of setting free energy in devastating explosions, as nuclear fission can be made to do, the sun's power will be harnessed by new photosynthetic installations as quietly as by those that now produce our forests, gardens and farms.

Plants Are Indispensible

Green plants are indispensible to life on earth. They alone are able to capture energy from sunlight and use it to build common atoms into comp'ex organic compounds. Some of these compounds teem with energy, so that they are capable of receiving additional atoms into their make-up, and letting others go. Life is essentially such a process. The living plant becomes food for the more complex life of animals, but animals cannot utilize for their food needs the water and carbon dioxide which support plant life.

The complementary ro'es of plants and animals in the cycle of life was noted more than a hundred years ago by Justus von Liebig. He observed how animals breathe in the oxygen of the air and breathe out waste carbon dioxide, while plants seize upon this carbon dioxide for their metabolism and give off oxygen into the atmosphere. Liebig was associated with Friedrich Wöhler, who showed that the products of life reactions follow ordinary chemical laws.

Present-day chemists like Harold C. Urey, who specu'ate upon the probable origin of the earth and the solar system, believe that the origin of all the oxygen of our atmosphere can be traced to green plants.

The green color of the plants is due to chlorophyll, a very complex chemical with an atom of magnesium at its heart. There is a degree of chemical relationship between this substance and the iron compound which makes blood red. In the leaves of plants, the green color is concentrated in structures known as chloroplasts. These chloroplasts are more chemical compounds than living entities, and are believed to be the key structures in photosynthesis carried on by plants.

A University of California group including Drs. Daniel I. Arnon, F. R. Whatley and M. B. Allen was able to isolate the little green chloroplasts and make them function outside the living plant. This opened the way to the demonstration of the food manufacturing process in three steps:

Three Steps in Process

1. The energy of sunlight is used to break down the water into hydrogen and oxygen. Part of oxygen goes off into the air. Part is used to build vitamins and a phosphate, adenosine triphosphate, called ATP, which are needed in the process.

2. Inorganic phosphate is changed to this ATP without need of atmospheric oxygen. This phosphorylation needs three vitamins made within the chloroplast, riboflavin or B-2, vitamin K and vitamin C.

3. With the aid of ATP and hydrogen, carbon is captured, some given off as carbon dioxide and some used in the starch, fructose sugar and other chemicals that photosynthesis produces.

This may seem complex, but it is

one of the most important processes in the world, and until now its details have been a major mystery.

Algae, the microscopic plants that form the green scum on stagnant pools of ditch water, are very convenient for the study of photosynthesis in the laboratory. In them the entire plant is engaged in the mysterious process the scientist wishes to study, and great quantities of algae can be grown in closed glass vessels. The amount of light that reaches them can be controlled. The light can be turned on and off, to find out what happens to the plant in light and in darkness. Gases can be fed to the plant and gaseous products can be led away and measured in the kind of apparatus the chemist likes to work with.

Many scientists are engaged in studying and measuring the various possible reactions and the conditions under which those reactions take place. As would be expected, the physicists concentrate on measuring and timing the reactions and calculating the energies involved, while the chemists specialize in learning what chemical elements take part in the reactions and how they combine with one another.

Light and Dark Effects

Observation shows that the chemical reactions in the leaf can be separated by alternate periods of light and darkness. While light shines on the chloroplasts they absorb energy at a rate that increases rapidly until the "steady state" is reached. During this time, the water-splitting reaction occurs. In the dark this reaction stops, but the plant builds up the products of the "light" reaction into more complex chemicals.

It seems as though it is only a question of time, and perhaps not a very long time, until man finds a way to apply photosynthesis, one of the greatest of natural processes, to his problem of how to live peacefully on this crowded planet.

Scientists working on the reactions in the living leaf are surprised to find how fast these changes occur. Experimenters tax their ingenuity to make the time of each reaction short enough so that they can find out what happened in one phase of photosynthesis before the next phase takes over.

Surprising Reactions

Some of the reactions prove to be very different from the methods the scientists expect. This is especially true of the chemical reactions by which the plant builds up its sugars and starches. Those reactions are just beginning to be understood.

Physicists, on the other hand, know a number of ways that water can be split into hydrogen and oxygen. They can measure how much electric energy is required, or how much heat, to accomplish the splitting, and therefore can calculate how much energy the plant requires to accomplish the same result.

But on the minute scale on which the plant works, atom by atom, an additional factor comes into the picture. Like atoms, energy comes in units, referred to as "quanta." A reaction must use all or none of the energy in each of these "packets." Calculations of the number of quanta of light energy taking part in photosynthesis have a disconcerting way of coming out in fractions. This contradicts well established laws of modern

physics which have solved so many other problems. The discrepancy sets another puzzle for scientists to work on.

One of the scientists who is working on this aspect of photosynthesis is Dr. Dean Burk of the National Institutes of Health. He finds that more energy is required for the entire process than would be furnished by one quantum from sunlight, but he believes that chemical energy is passed back and forth as the successive reactions take place. In an article published in 1953, he explains how this works.

"Chemosynthesis and photosynthesis thus work together in the assimilation of carbon dioxide in green plant cells. Chemosynthesis furnishes the energy lacking in the light quantum, and then gains back its spent fuel by utilization of the light quantum photochemically. In this way Nature provides that the energy-deficient quanta of visible light can accomplish an overall photochemical reaction that requires three times the energy of a single light quantum."

Attacking the problem from the chemical side is Dr. Melvin Calvin at the University of California. His approach is to try to find the earliest product of the synthesis carried on by the leaf.

Radioactive Isotopes

If it were not for radioactivity, today's chemists would be limited, as were those of past centuries, to guessing at what these chemical products are, and then trying to make in the laboratory the products they had imagined. The early chemists who tried this guessed wrong. With the production in recent years of different isotopes of the chemical elements, it is now possible to follow reactions in living tissues and find out what is really happening there.

By substituting for commonly occurring atoms their radioactive isotopes, or, in some cases, stable isotopes of different mass, chemists can force plants to take up carbon dioxide, water or solutions of salts which can be identified in plant tissues or in the products they form.

Phosphorus Essential

In this way, the oxygen given off by living plants has been proved to come from the water they use, not from the carbon dioxide they "breathe." Radioactive carbon 14 points out the course of carbon synthesis in the leaf. Recently, in the researches carried on by Dr. Calvin's group in California, phosphorus 32 has shown phosphorus to be essential to the formation of the carbon compounds that first appear in the leaf.

Photosynthesis is proving to be a cyclic process in which two sugars, ribulose and sedoheptulose, with five and seven atoms of carbon, respectively, combine with phosphate groups only to be torn down again and recombined as carbon is repeatedly brought into the life process from outside.

The five-carbon group, appearing in plants as ribulose, is found again in deoxyribonucleic acids, which are very close to being the chemical source of life.

Just as chemists a century ago solved the problem of making organic chemicals, modern scientists believe they can solve the energy problems concerning the way nature builds organic

chemicals in living cells. When those problems are better understood, man may be able to improve upon some of the ways in which he now uses natural products for food and materials.

Some scientists think plants use sunshine pretty efficiently, others think the green leaf does not turn fuel into usable energy with anything like the economy of a man-made engine. However that may be, for the individual leaf, it is certain that man currently gets the benefit of a very small fraction of the energy the sun pours onto the surface of the earth every day.

Engineers like to calculate that, given ways to make more efficient use of all that energy, they could provide comfortable living conditions for the human race in many places now inaccessible.

Some of these places, which might be habitable if photosynthesis were a going concern, would surely be the deserts of the world, where so much sunshine is available. The arctic regions, especially in "summer" when the sun shines 24 hours a day, would also be inviting.

Ability to grow plants without the limitation of good soil would allow colonization of mountain peaks and of many islands. Add the ability to derive fresh water from salty, and perhaps the surface of the ocean would become available for colonization.

In seeking new homesteads, mankind may well return to caves, and transfer the skill that invented "skyscrapers" to building down instead of up. All this offers many solutions for the housing problem, without venturing with the "science fiction" addicts out into space.

There has been some serious speculation that the one-celled plants, such as chlorella, which scientists find so convenient for photosynthesis studies, may become a future food supply. Those who have tried them do not find them very appetizing as yet. But one-celled organisms have long been concerned with the preparation of our food. Wine and beer, bread and cheese, sauerkraut and pickles all owe their flavor to these lowly forms of life. If we can bring in the ancient skills that developed these arts in food preparation, we need not fear that the new food resources will not be tasty.

On the Back Cover

➤ NOT FOR FUN *is this scientist running his new electric train. He uses it for safety, to transport radioactive materials too hot to get close to, in the laboratories of Hanford Atomic Products Operation, operated by the General Electric Co. for the Atomic Energy Commission.*

300-Degree Temperature In New Solar Oven

Sun Harnessed for Cooking

by Richard Magat

➤ Scientists have launched a concentrated effort at harnessing the sun for cooking.

Sunshine is the cheapest available "fuel" for millions of families in underdeveloped areas who cannot afford shiny new stoves or even coal.

A solar energy scientist at New York University, Dr. Maria Telkes, has conceived a practical, economical stove that cooks by sunlight. Now the Ford Foundation is backing the project with a grant of $45,000 to the Research Division of NYU's College of Engineering for detailed research and development of a sun stove.

Why all this activity about one of man's oldest and simplest chores?

First, many areas like India either lack their own fuel reserves or the means to import fuel on a large scale. As a result, lower-income families have used the only fuel available—the vegetation around them. The total effect of deforestation and soil erosion from this practice is tremendous.

Secondly, as vegetation became scarce, dried animal dung became the only remaining cheap, available fuel. It is estimated that in India, 78% of the yearly fuel requirements are filled by dried cow dung.

Besides the health and esthetic drawbacks to this practice, it plays havoc with agriculture in areas that already suffer from food shortages and periodic famines. The natural animal fertilizer now burned as fuel could revitalize the soil and materially increase crop yield. Experts estimate that the use of animal fertilizer for cooking now cuts the productivity of the land by nearly half.

The NYU project ranges beyond engineering aspects. Dr. Ethel Alpenfels, professor of social anthropology, is reviewing the social and economic patterns in countries of the Near East and India. Concurrent with the scientific development of the cooker, therefore, the social, psychological and economic effects of introducing and integrating such a new device into the customs of the peoples will be determined.

Materials Available

Also important, and another area of the study, is an industrial and materials survey of these countries. What materials are available for incorporation into the sun stove? What skills are available for its manufacture? What is the country's industrial potential for its mass production?

Cost is a crucial factor in introducing solar cooking to underdeveloped areas. The most successful solar cooker developed to date involves a costly parabolic (shell-shaped) reflector.

Dr. Telkes' stove design eliminates the need for parabolic reflectors. Furthermore it has the advantage of retaining cooking heat for an hour or so after the sun has gone down, the time when the evening meal is cooked. For another thing, its heat-storing feature largely eliminates the necessity of

▶THIS SOLAR OVEN *is being tested on an October day of moderate sunshine. The oven's temperature gauge is topping 300 degrees Fahrenheit, although it is shirt-sleeve weather. Dr. Maria Telkes, its inventor, samples a morsel while Technical Assistant Fatolah Sotoodeh of Iran prepares to run an independent analysis of sun-cooked food.*

changing the position of the stove frequently to catch direct sunshine.

Her stove is a closely insulated box, roughly triangular in shape. Four ordinary flat mirrors fan out from the tilted face of the stove. At the rear of the stove is a removable drawer through which the food is placed.

The mirrors reflect sunlight down through the tilted face of the stove, concentrating them in the interior, which is filled with special heat-absorbing chemicals.

Heat of Transformation

Principle of the stove is "heat of fusion," or "heat of transformation." All materials when melting require large amounts of heat to change from solid to liquid forms. During melting, the temperature of the material does not change but remains at the melting point. The problem in the solar stove and other heat storage devices is to devise materials with relatively high heat of fusion.

In the sun stove, therefore, the sun's heat produces a succession of changes in the heat-storage salts from solid to liquid state. The changes give off the heat used for cooking.

Cooking Temperature

Preliminary models of Dr. Telkes' stove have developed temperatures up to 300 degrees on days when outdoor temperature was under 70 degrees Fahrenheit.

From 250 to 300 degrees is considered ample for average cooking operations. Higher temperatures needed for frying and browning have been developed in the stove on clear days. The areas for which the stove is intended enjoy direct sunlight most of the year. The New York University research group believes their stove can be developed so that it can be manufactured for $5. This is the maximum sales cost estimated by the Hindu Government and the British Committee for Solar Energy Utilization. There is a potential need for 100,000,000 solar cookers in India alone.

The least expensive solar cooker devised to date sells for about $16. Besides cost and conformity to local cooking custom, the NYU stove will be designed to meet these requirements: durability, ease of operation and cleaning; simplicity and portability; ability to operate in early evening, and little attention required during cooking.

Pioneer in Solar Energy

The solar stove is an outgrowth of Dr. Telkes' many years of pioneering in the solar energy field. During World War II, for example, she was mainly responsible for a solar still that converted salt water into fresh water. The still was issued as standard military equipment for inflatable liferafts and is credited with saving the lives of many shipwrecked servicemen.

Dr. Telkes has also designed a sun-heated house that is occupied the year 'round by a family in Dover, Mass. Besides her solar energy research at NYU, she is currently engaged in a study supported by the U. S. Department of the Interior Saline Water Conservation Project. This involves development of large-scale solar stills to convert sea water and underground saline water to fresh water. If successful, it would open large semi-arid areas of the United States to irrigation and new possibilities for agriculture and industries.

Renato Contini, NYU research coordinator, who will coordinate all aspects of the program, has stated that, "a progressive change to solar cooking, and the possible utilization of solar energy for other purposes, would mean a continuing improvement in the standard of living.

"The increasing productivity of the soil may lead to the introduction of other improved tools . . . initiating a chain reaction of social and economic events leading to a total betterment of these societies."

Other Solar Cookers

Many attempts to develop solar cookers have been made in the last hundred years. Mouchot in France and Adams in India built solar stoves around 1870, but their devices did not become popular despite the fact that Mouchot's work was supported by the French Government. The Smithsonian Museum has exhibited a solar cooking device designed by Dr. C. G. Abbot in 1925.

A cooker being manufactured on a limited scale was designed by Dr. M. L. Ghai in the Hindu National Physical Laboratory, New Delhi. This employs a parabolic reflector, and while it is suitable for boiling it is not adaptable to baking.

The solar energy project, says Dr. Telkes, is one means of attacking a problem stated last April by Dr. Herman E. Hilleboe, president-elect of the American Public Health Association. Dr. Hilleboe stated:

"Most underdeveloped areas in the world today are that way because of their inability to make effective use of their natural resources. Recently, diffusion of cultural patterns from well developed areas has proved to be a powerful stimulus to backward nations to improve their social and economic status.

"There is a growing demand by people of 'have not' areas to improve their health, education and welfare, to develop their natural resources, to profit by the scientific knowledge of other more advanced nations."

It has been authoritatively said, Dr Hilleboe went on, that modern engineering makes it possible to alter completely the social and economic status of any area in the world.

The NYU project is employing trained personnel from the areas where the solar cooker may be introduced. The first of these is Fatolah Sotoodeh, a graduate mechanical engineer from the University of Teheran, who is currently a candidate for doctor of engineering science in industrial engineering in NYU's College of Engineering.

It is anticipated that some assistance may be obtained from the University of Teheran, the American University of Beirut, the Near East Foundation and appropriate United Nations agencies.

To the geologist, volcanoes are a surface phenomenon; the origin of their energy is at most 25 to 30 miles below the surface of the earth.

Thirteen crops account for 90% of the vegetable oils of commerce; the most important are coconut, peanut, cottonseed, soybean, rape, mustard, flax and the olive.

Natural gas traveling through pipelines from production fields in Texas to consumers in the eastern states travels at a rate of from 14 to 25 miles an hour.

Stars, Meteors, Magnetic Storms, Affect Earth, Explain Universe

Chemical Events Outside the Earth

➤ ACCURATE prediction of the blackouts and other disturbances that hamper long-distance communication by short wave radio is forseen, using a new method.

Its aim is to take the guesswork out of forecasting geomagnetic disturbances.

For the first time, scientists now have a theory on which to base their forecasts of the giant magnetic storms caused by the charged particles being shot at the earth from the sun. These magnetic storms not only cause blackouts of radio communications, but the brilliant displays of "northern lights" and erratic movements of compass needles.

The charged particles ejected by the sun are focused by magnetic fields above the sun's surface, suggest Dr. Jean-Claude Pecker and Dr. Walter Orr Roberts, director of the High Altitude Observatory, Boulder, Colo.

For the last two months, experimental forecasts have been made on the basis of the new theory. Results so far, Dr. Roberts said, have been "extremely promising."

The High Altitude Observatory scientists are cooperating with radio experts at the radio research laboratory of the National Bureau of Standards, the Central Radio Propagation Laboratory, also in Boulder. There, using the new theory, Standards scientists are also making experimental forecasts of geomagnetic activity to see how closely predictions made by two separate groups agree.

Agreement so far has been encouraging, Dr. Roberts said.

There are two principal sources of the charged particles, or corpuscles, that bombard the earth. One is the active regions, where great sunspots are often formed. The other is the spicules, small gaseous jets that cover the sun's surface.

Corpuscles coming from the spicules and focused by far-distant active regions are the source of the magnetic storms that recur every 27 days. These storms are now predicted by radio experts of the Central Radio Propagation Laboratory by an empirical method, which depends somewhat on the personal experience of the forecaster.

The new theory should eventually reslt in an objective method, with forecasts being made by punched card machines.

Discovery of the importance of the spicules in producing geomagnetic storms resulted from looking at the white light of the corona, the giant pearly white halo of the sun so spectacularly visible during an eclipse.

Meteorite Mysteries

➤ INCREASED studies of meteorites, from outer space, may provide clues to some of the mysteries of our universe.

Dr. Frederick C. Leonard, professor

of astronomy at the University of California at Los Angeles, explains that each year hundreds of meteorites land on the earth. Dr. Leonard believes it almost incredible that the only tangible objects of astronomical inquiry have been so sadly neglected for so long a time.

In a systematic survey, he has found at least 50 problems in the field of meteoritics, which, when pursued, may help to explain the universe.

Among these problems are:

1. The origin of meteorites and the role that they have played in the evolution of both the solar system and the cosmos.

2. Determination of the cosmic or absolute ages of meteorites by as many independent methods as possible.

3. Additional chemical and mineral analyses of meteorites, especially determinations of the percentages and distribution of trace elements and isotopes in them.

4. Further studies of meteoritic clouds and meteoritic trains.

5. Improved methods, especially photographic, for observing meteors.

6. Improved classifications of meteorites, according to their internal structure and mineral composition.

Stars 200,000 Times the Sun

➤CONSTELLATIONS of blue stars in the Large Cloud of Magellan, the nearest galaxy to our own Milky Way system of stars and nebulae, contain a few supergiant stars more than 200,000 times as bright as our sun.

This is a remarkable situation, Drs. Harlow Shapley and Virginia McKibben Nail reported to the National Academy of Sciences meeting at Columbia University recently. It means that just one of these extremely luminous blue stars sends out more energy than is emitted by all the tens of thousands of giant and average stars in the average globular star cluster.

Drs. Shapley and Nail also reported that they have discovered that many of the supergiant stars are reddish, variable, and in radiation exceed the sun 50,000 times.

The Magellanic constellations, in which the very hot blue stars are found, are each composed of a score of supergiant stars similar to those found in the well-known winter constellation of Orion, the giant hunter.

An unexpected finding of the astronomers' Magellanic Cloud survey was that the variable stars known as cepheids in the west end of the Large Cloud's stellar axis are larger, brighter and have a longer period than those in the center or at the east end of the axis.

As photographic and radio telescope techniques for studying this nearby galaxy are improved, Drs. Shapley and Nail predicted that astronomers will unravel both the form and the inner turbulences of this important galaxy.

This would lead to a much better understanding of how our own Milky Way galaxy was formed and is evolving.

New Blazing Star

➤A GREAT star has suddenly burst forth in the heavens, a supernova as it is known to astronomers.

For the fifth time in a year Paul Wild, astrophysicist of the California Institute of Technology, has reported a supernova. This one is a relatively faint 14.5 magnitude although it was a great astronomical explosion to that far distant part of the universe.

It was observed Sept. 27, 1954, and

is located two-tenths of a minute of arc south of the nucleus of the spiral galaxy NGC5879.

Mt. Wilson and Palomar Observatories reported this discovery through Harvard Observatory, clearing house of astronomical observations for the Western Hemisphere.

Research Laboratories Listed

➤ RESEARCH LABORATORIES serving industry as "cradles" of new ideas and developments are being listed anew by the National Academy of Sciences and the National Research Council, Washington, D. C. Officials of these organizations are on the search for new laboratories or others that might have been overlooked in previous directories.

➤ "SOMETHING'S *gone wrong with our new plastics formula —all we're getting is gold, silver and platinum!*"

Bacteria, Not Acid, Seen Tooth Decay Cause

Possible Factors in Tooth Decay

➤ TOOTH DECAY may become widespread inside a tooth before it can be detected by the dentist.

This is one implication of a departure from the conventional theory of dental caries which results from research conducted by Valerie Hurst and Drs. Harry E. Frisbie and Max S. Marshall of the University of California College of Dentistry.

The most widely accepted idea of tooth decay holds that an acid produced by bacteria (lactobacillus acidophilus), makes holes in the enamel and gradually destroys the softer, inner dentin. If this is correct, the damage first appears on the tooth surface where the dentist can see it in the early stages.

But the California scientists say acid erosion may not account for all caries. They have reported evidence that bacteria may directly penetrate the enamel in minute thread-like chains, then spread out and destroy the dentin. The original hole in the enamel may be too small to be detected by the dentist.

The new theory has been developing for a number of years. First, the late colleague of the three California scientists, Dr. James Nuckolls, found that the thickness of enamel on the teeth varies greatly from one point to another. It had been thought that enamel was of uniform thickness, and was too tough for bacteria to penetrate on their own at any point.

In a recent series of scientific papers, the three California scientists have presented evidence that bacteria can penetrate the enamel, apparently at thin spots, either in thread-like chains or spearhead concentrations. Bacterial invasion, then, may be the first step toward caries, rather than acid penetration.

The scientists believe the lesions they produced in hamsters' teeth more closely resemble the early microscopic pattern of tooth decay than those in experimental caries produced by acid. They point out that the acid conditions of the test tube are not likely to be present in nature.

The researchers report that their evidence for direct bacterial invasion is not yet complete, and they are continuing their work.

Artificial Mouth

➤ IF CLEAN teeth decay, the destruction is confined mainly to the noncleansed areas and to previously worn areas and areas around the necks of the teeth between the crown and the roots.

Studies with an artificial mouth of teeth showed this to Dr. Ward Pigman of the University of Alabama Dental School and Medical College at Birmingham.

The artificial mouth is made of human teeth that have been extracted. They are mounted singly or in pairs and placed in cylindrical funnels. A bacteriological medium, which Dr. Pigman calls "artificial saliva," is al-

lowed to flow dropwise over the teeth for several months.

Old teeth, he found, seem to be more resistant than young or unerupted teeth. There is evidence for the presence of a protective surface film.

The attack by caries is greatly influenced by the amount of sugar in the artificial saliva. With only a small amount present, less than one-tenth of a percent, sound teeth remain unchanged for long periods, Dr. Pigman found. With a relatively large amount of sugar, for example five-tenths of a percent, enamel attack and decalcification of exposed dentin goes on rapidly.

A strain of *Lactobacillus casei* found in human mouths produced decalcification but did not affect the dentinal matrix. On the other hand, a mouth strain of *Streptococcus salivarius* produced decalcification and matrix destruction. Dr. Pigman comments that "in view of the usually accepted role of lactobacilli in the carious (decay) process, these results seem particularly interesting."

Details of the studies are reported in the journal, *Science*.

Thermal Shock

➤ OUR AMERICAN habit of eating intensely cold and piping hot foods at the same meal may be to blame for much of our tooth decay.

Such thermal shocks, or rapid temperature changes from boiling water to ice water, made otherwise healthy human teeth more vulnerable to cracking under crushing tests, Douglas G. and Herbert A. Pohl of Wilmington, Delaware, found. Dr. Herbert Pohl is a research chemist with the Du Pont Company.

Of a group of teeth given 72 thermal shock cycles, 21 of 50 broke under the crushing. Of a group of control teeth not subjected to the temperature change shock, 11 out of 50 broke in the crushing tests.

Cracking caused by repeated thermal shocks may open the way to decay, the Pohls suggest. They point out that one effect of thermal shock on vitreous materials, such as tooth enamel, is to induce small cracks which speed mechanical breakdown.

The large increase in tooth decay in the U.S. since the turn of the century undoubtedly has considerable connection with changed eating habits, the Pohls state. One of the changes is that of eating intensely cold and hot foods at the same meal, for example, eating food served at 150 degrees Fahrenheit and a moment later taking a swallow of ice water.

Color Test Shows Pine Decay

➤ A CHEMICAL solution, painted on the freshly cut ends of poles, pilings or posts provides a simple color test for detecting early decay in southern pine, the U. S. Department of Agriculture announces.

When a solution of Alizarine Red S is applied to the ends of southern pine stock, decay-infected areas turn yellow, whereas, healthy wood stains a bright red.

The test was developed by the Forest Products Laboratory at Madison, Wis. The Alizarine Red S is available at chemical supply houses.

The Forest Service states that this new test detects southern pine decay faster than any other known method.

Anti-Scurvy Wild Cherry Juice Now Being Canned

More Vitamins From New Foods

➤ A CHERRY a day keeps scurvy away. But it takes a particular kind of cherry to do it. It is a West Indian cherry known as acerola and only distantly related to the cherry family.

This acerola, or West Indian cherry, is said to be the richest edible fruit source of anti-scurvy vitamin C. But since it is a very perishable fruit, few could get their vitamin C from the cherry-a-day practice. We will be able to get it soon, however, in canned fruit juice.

Discovery of the very high content of the acerola was announced by Dr. Conrado F. Asenjo and Dr. Ana Rosa Freire de Guzman of the School of Tropical Medicine, San Juan, Puerto Rico, in 1946.

Harvey Greenspan, chairman of the board of the BiB Corporation, has recently announced that his company has begun processing the acerola juice and will soon market it blended with apple, pear, pineapple, tomato and other juices as a natural protective food for infants and children.

Small amounts of acerola juice added to fruit juices poor in vitamin C can produce blends with a vitamin C content well above the average orange juice, Dr. Asenjo states.

Although the small, bushy acerola tree has apparently grown wild in Puerto Rico for over 2,000 years, it is such a poor germinator that it took almost eight years of experimental work before scheduled crops could be guaranteed on a large enough scale to enable BiB Corporation to start processing it for the market. Dr. Arturo Roque and agronomist Enrique Molinary of the University of Puerto Rico's Agricultural Experiment Station did the experimental work leading to development of acerola as a cash crop tree.

Cuba Enriches Flour

➤ CUBA is joining the United States in providing that its people eat vitamin-enriched flour to prevent dietary diseases.

Cuba's legislative executive council has recently provided that wheat flour sold in that nation shall have thiamin, riboflavin, niacin and iron added to it. This enrichment will help prevent beri-beri, pellagra, and nutritional anemia and build up human vigor generally.

Cuba's Foundation for Medical Investigations has notified the Williams-Waterman Foundation, New York City, of this action. Similar enrichment of rice will be provided.

Enriched flour has been used in the United States since the days of World War II. Enriched rice is a newer development worked out under the research fund set up from the income received by Dr. R. R. Williams, head of the fund, for his synthesis of vitamin B-1, or thiamin. Dr. Williams is also assistant to the president of the Research Corporation.

In experiments in the Philippines it was shown by Dr. Williams and associates that the desired vitamins can be

added to make highly fortified rice grains and then a pound of these grains can be mixed in each 200 pounds of rice to give the nutritionally desirable food.

Both Puerto Rico and the Philippines are taking legal steps to provide enriched rice to the population. Because all rice used in Puerto Rico is imported, it can be enriched at central locations. In the Philippines, which grows much of its own rice, the enrichment must be done at 5,000 local rice mills and the law is being applied gradually province by province.

Progress is being made in providing vitamin-rich grain products in Latin America. Guatemala, Costa Rica, El Salvador, Honduras and Panama are applying regulations to imported wheat flour, and about half of Chile's flour is now so treated.

Locally grown corn is difficult to enrich because it is milled locally. In the United States about three-quarters of the corn meal in the South is enriched.

One problem in rice enrichment is being encountered. The riboflavin colors the highly fortified grains yellow. Meticulous cooks were found to take out the yellow grains, mixed one in 200 grains, believing them defective. The riboflavin is therefore omitted from rice enrichment now, but ways of masking the yellowing effect are being developed.

The amount of enrichment of wheat flour in the United States, which is generally followed for other grains and localities, in milligrams per pound is: thiamin, 2; riboflavin, 1.2; niacin, 16; and iron, 13.

More Food Needed

➤ VAST INCREASES in food needs are foreseen by the Food and Agriculture Organization of the United Nations as a result of expected population increases.

The FAO report admits the hopelessness of reaching "fully satisfactory nutritional standards" because the "attainment of such standards is clearly impossible in the near future over large areas of the world." A somewhat lower and more nearly realizable dietary level has been set as a target, but even to reach this would require large increases in food supplies.

In the world as a whole, during the next 25 years, supplies of cereals—the most important of staple foods—need to be increased by 43%, according to FAO estimates, merely to feed the extra mouths at recent nutrition levels, whereas to achieve modest improvement would require an additional 10%. To reach the improved levels, fish supplies would have to be augmented 88% and milk some 70%.

Disparities in local production are still more marked, with the required increase of cereals in the Near East to reach the improved level being some 78% and for milk, 81%.

The report does not forecast whether or not the target levels will be reached but states that though there may be no technological reasons why food production cannot be raised by the indicated order of magnitude, this would call for a much greater effort than is envisaged at present.

The mineral Chrysolite, meaning golden fibers, or threads, supplies over 90% of the world's asbestos requirements.

Synthetic Chemical Stops Pain of Tic Douloureux

Synthetic Drugs Solve Problems

▶ A 70-YEAR-OLD man who suffered attacks of excruciatingly painful tic douloureux every two months for 17 years has been free of these attacks for 20 months, thanks to a new treatment.

The treatment consists of doses of a synthetic chemical called stilbamidine. Its ability to banish the pain of tic, or trigeminal neuralgia as it is also called, was discovered almost accidentally by Drs. George W. Smith and Joseph M. Miller of the Johns Hopkins Hospital, Baltimore, and the Veterans Administration Hospital, Fort Howard, Md.

They had been using the chemical to treat certain rare diseases such as leishmaniasis and blastomycosis. These patients after a few weeks complained of facial numbness. They had lost the winking reflex and could not taste or feel food in their mouths. After some time more, these sensations disappeared. Apparently the stilbamidine had hit the fifth nerve as streptomycin hits the eighth nerve. Since the fifth nerve is the one involved in tic, the doctors decided to try stilbamidine as a remedy for the painful ailment.

The first patient, an 82-year-old woman, has had complete relief of her tic pain for 30 months. In all, some 40 patients have been treated. They had, many of them, had previous standard treatments such as alcohol injection into the nerve to deaden it, injections of vitamin B 12 and operations in which the nerve was partially cut.

None of these had given relief for more than a few months. But with stilbamidine they get complete and apparently long-lasting relief. Only permanent relief heretofore available for these patients has been an operation in which the fifth nerve was completely cut.

The numbness and other strange sensation effects of stilbamidine wear off after a few weeks but the pain relief remains. Why is not known. The drug was at first given by injection into a vein every day for 14 days. But now the W. S. Merrill Co. of Cincinnati is making it for Drs. Smith and Miller in capsule form. Patients swallow one of these capsules every day for two weeks.

Stilbamidine's ability to check blastomycosis was itself an almost accidental discovery.

A Cherokee Indian had been sent to the Fort Howard VA Hospital with the diagnosis of cancer of the esophagus. Actually, he had been sent there for "terminal care," since he was not expected to live. But at Fort Howard it was discovered that he did not have cancer. Instead he had the rare fungus infection, blastomycosis.

Discussing the case with scientific friends in Baltimore, Dr. Miller learned of a chemical that cleared fungi from culture plates much as penicillin cleared staph. germs from culture plates. This chemical could not be given to humans safely, but Dr. Miller learned of the safe, related chemical, stilbamidine. So he tried that and the blastomycosis patient was cured.

Slows and Steadies Heart

➤ A DRUG that can both slow the heart and steady its beating has been synthesized by Drs. S. Margolin, Go Lu, J. Yelnosky and A. Makovsky of the Pharmaceutical Research Department of the Schering Corporation, Bloomfield, N. J.

Dr. Margolin is now with the pharmaceutical department of the Maltbie Laboratories, Morristown, N. J., and Dr. Lu is with the Johnson and Johnson Research Foundation, New Brunswick, N. J.

The drug has the laboratory code name Sch 2684. Chemically, it is 16-cyclohexylamino-allopregnandiol.

Its effects in slowing and steadying hearts that were beating too fast and out of normal rhythm were shown in laboratory animals. The scientists think it worthy of trial in patients with certain types of heart disorders.

Blood Pressure Lowered

➤ GOOD RESULTS with first trials of a new blood pressure lowering drug that is taken by mouth were announced by Dr. Keith S. Grimson of Duke Medical School and Hospital, Durham, N. C., at a recent meeting of the American College of Physicians.

The new drug is called Su-3088. Chemically, it is dimethyl-aminoethyl tetrachloroisoindolene bismethochloride. It was synthesized by Dr. Albert J. Plummer and associates at the Ciba Foundation, Summit, N. J.

One small tablet of Su-3088 taken before breakfast reduces blood pressure to normal throughout the day, Dr. Grimson found in trials with 15 patients.

"This drug is not for mild hypertension (high blood pressure) or for severely advanced patients who have coronary, renal, or cerebral damage," he said. "It may, however, prove to be helpful for a great majority of hypertensive patients, and at one tablet a day should be a real financial saving."

The drug achieves its blood pressure lowering effect by its action on nerve centers. In this it is like hexamethonium and related compounds. In the trials so far, however, it seems to be more uniformly effective when given by mouth.

Although only small quantities have been available so far, more is now being made.

Antibiotic Clears Acne

➤ SMALL DAILY doses of an antibiotic called Tetracyn, or tetracycline, brought good results in patients with acne which had not been helped by other treatments such as sulfur-resorcin lotion, carbon dioxide slush, X-rays and hormones.

Of 75 patients, one-third got "excellent improvement," another third got "good" improvement, and one-third only fair improvement, Drs. William C. King and M. Allen Forbes Jr. of the University of Texas Medical Branch, Galveston, reported at the Second Annual Symposium on Antibiotics.

The patients have been observed from one to three months and most are still under observation. Why such small doses of the antibiotic give such good results is not known. Bacteriological studies now under way will, the scientists hope, give the answer to this question.

Parrot Fever Prevented

▶ THE DANGER of humans getting parrot fever, or psittacosis, from parakeets and other birds can now be eliminated. The report comes from one of the foremost authorities on parrot fever, Dr. K. F. Meyer and his associate, B. Eddie, of the George Williams Hooper Foundation, University of California, San Francisco.

The way to stop this disease threat to humans, Dr. Meyer and associate have found, is to have breeders treat their birds with either chlortetracycline or tetracycline. These two antibiotic drugs are better known as Aureomycin and Achromycin. Aureomycin is regularly used to cure humans who contract the disease from birds.

The California investigators gave twice daily injections of Aureomycin or Achromycin to 181 parakeets for 14 days from flocks known to be infected with latent psittacosis. All of the birds who were sacrificed proved free from psittacosis, and no evidence of infection was found in their offspring.

A related disease known technically as ornithosis can similarly be stopped from spreading to humans by treating squabs in breeding establishments, the California scientists found.

Squabs in various stages of natural acute and latent ornithosis, which proved fatal to 50% of untreated birds held under observation as controls, were freed from the infection when injected three times a day for 25 days.

Hormones and Antibiotics

▶ THE NEW WAY to treat serious infections is to use both an antibiotic, such as penicillin, and one of the hormones famous as anti-arthritis drugs, cortisone, hydrocortisone or corticotropin (ACTH).

Success with this double-barreled attack on disease germs was reported by half a dozen doctors from different parts of the country at the second annual symposium on antibiotics held in Washington, D. C., recently.

Heretofore doctors have considered it dangerous to give the hormones to patients with infection. This was because laboratory animals with infections usually died if given these hormones.

The hormones, however, have two effects which should be helpful in fighting infections: 1. a profound anti-inflammation effect; and 2. a non-specific antitoxic effect which acts to counteract poisons from disease germs.

The advantages of the hormones can be realized if they are given with a suitable antibiotic and if certain other precautions are observed, Dr. Laurance W. Kinsell of the Highland Alameda County Hospital, Oakland, Calif., reported.

Experience during the past four years shows that giving the corticoid hormones results in rapid and striking clinical improvement with lessened toxicity of the system. If antibiotics are given at the same time, deaths and sickness can be lessened without any untoward effect of the corticoid.

A high calorie, high protein, high potassium and low sodium diet must be given at the same time. Corticotropin must be given at least one day longer than cortisone, to prevent any residual damage to the adrenal glands. And the antibiotics must be given for at least three days after all hormones have been stopped to protect against

any spread of the infection which might result from residual effects of the hormones.

Dr. Kinsell's hospital now uses this treatment as a routine in all patients with non-tuberculous meningitis; in very weak patients with generalized peritonitis or any patient with peritonitis of more than 24 hours duration; and in any patients with an infection where it seems probable death will occur before the antibiotics have time to do their work.

Dramatic improvement following this treatment in five patients severely sick with infectious mononucleosis was reported by Drs. Edward L. Quinn, David Bunch and Muriel Carson of the Henry Ford Hospital, Detroit.

Prompt relief of symptoms with improvement or cure in 22 of 24 external eye infections followed this treatment, Capt. Robert W. Neidlinger of Brooke Army Hospital, Fort Sam Houston, Tex., reported.

Ointments and lotions containing both antibiotics and hydrocortisone have proved valuable in treating certain skin conditions, Dr. Harry M. Robinson Jr. of Baltimore reported, particularly where pus is a complication of the eruption.

Machine to Show Shell Egg's Quality

➤ A MACHINE will some day do the entire job of detecting the quality of eggs in the shell, Dr. A. W. Brant of the U. S. Department of Agriculture predicts.

Mechanical methods can now determine nine of 11 major factors which make up current ideas of shell egg quality. Still to be developed are mechanical methods for measuring albumen quality and for "screening" for defects.

The nine quality factors that can now be determined by machine are egg size, shape, cracks, shell strength, air-cell size, blood, Pseudomonas or green rots, shell color and yolk color.

Mechanical methods for determining these were described by Dr. Brant and K. H. Norris, agricultural engineer of the department, at the World Poultry Conference, Edinburgh, Scotland, as follows:

Egg size is determined by weighing the eggs as they are moved by a conveyor. Egg shape determination requires only the application of known principles of electronic accepting or rejecting signals received from mechanical "feelers." Crack detection is accomplished through mechanical tapping and "listening" (an adaptation of the long known art of "clacking" eggs).

Shell strength can be determined by applying known stresses to shells and accepting those undamaged by the treatment. The worth of this principle lies in its ability to salvage weak-shelled eggs that would ordinarily crack during marketing and be lost. Air-cell size is reflected with a high degree of accuracy by measuring the absorption of radio-frequency energy.

Presence of blood, presence of Pseudomonas rots (commonly called green rots), shell color and yolk color can be detected—and classified where necessary—by appropriate use of light transmitting, reflecting or fluorescing properties of the egg.

Chemists Cut ACTH Into Eight Parts

New Ammunition Against Arthritis

ACTH, pituitary gland hormone famous for its relief of painful, crippling arthritis among many other ailments, has been chemically cut up into eight equally active components, Dr. Paul H. Bell of a research division of the American Cyanamid Company has announced in a report to the American Chemical Society's *Journal*.

One of these, known as beta ACTH, can do everything ACTH can. This is the most abundant component of the hormone, contains 39 amino acids and has a molecular weight of 4,566. The isolation and discovery of the chemical make-up of this part of the ACTH hormone is expected to lead to better understanding of ACTH, the adrenal gland and various diseases, though not necessarily to synthesis of the drug.

New and Old Drugs

NEW AND old drugs are holding the fort against the rheumatoid diseases, from gout to arthritis, while scientists seek the basic cause of these ailments and a single specific cure.

Progress with both the drugs and the basic research was reported at an American Rheumatism Association meeting in the Clinical Center of the National Institute of Arthritis and Metabolic Diseases. The newest of the drugs that show promise are on trial at this national arthritis institute.

Gout, said to be the oldest known disease of man, can now be effectively attacked by a fast-acting drug called phenylbutazone, Dr. Charley J. Smyth of the University of Colorado School of Medicine, Denver, reported.

Although there is no known cure for gout, Dr. Smyth said, the control of the frequency and severity of acute attacks is now quite satisfactory. In contrast to other forms of arthritis, the treatment of gout is relatively effective and with the acute attacks properly managed the results are frequently dramatic.

Dr. Smyth in his investigation studied the effect of phenylbutazone at various blood levels upon the blood and urinary uric acid in 10 gouty and eight non gouty arthritics.

A step-wise fall in blood uric acid to normal, Dr. Smyth said, occurred in all but two of the gouty patients. The excretion of uric acid was increased in all but one patient and the maximum output occurred before the maximum fall in the blood level.

Dr. Smyth said clinical benefits usually began within a few hours and that the majority of patients experienced a complete remission in 48 hours or less. He said the new drug was found to be effective in patients resistant to colchicine, a drug that has been used in the treatment of gout since as far back as 1500 B.C.

The basic problem in arthritis, scientists now believe, exists in the connective tissue, the web-like framework which holds the human body together. Inflammation of this tissue is known as arthritis when it exists in the joints. When it exists elsewhere in the body

it is known as rheumatism or by some other specific name such as rheumatic fever.

For early treatment of rheumatic fever, aspirin combined with one of the adrenal or pituitary gland hormones was suggested by Dr. Edward E. Fischel of the Bronx Hospital and Dr. Charles W. Frank of Presbyterian Hospital, New York. Giving an adrenal or pituitary hormone over a long period may result in serious toxicity, they warned.

On the other hand, they said, short-term treatment with the hormones cortisone, hydrocortisone or ACTH, is almost always followed by a flareup of rheumatic inflammation. To guard against such flareups, they recommended prolonged and uninterrupted use of aspirin.

A newly refined test for rheumatoid arthritis that is 92% accurate was reported at the meeting.

The test, using sensitized sheep cells and a euglobulin blood fraction taken from an arthritis victim, is still in the research stage. It was developed by The Study Group on Rheumatic Diseases of the New York University College of Medicine.

Promising in Early Trials

➤ Promising results in first trials of two new, partially synthetic drugs for arthritis were reported by Dr. Joseph J. Bunim, clinical director of the National Institute of Arthritis and Metabolic Diseases, at the end of a scientific session of the American Rheumatism Association held at the Institute.

The drugs are called metacortandralone and metacortandrosin. They are steroid chemicals and were developed by the Schering Corporation of Bloomfield, N.J. The first patient to get either of them got his first dose on Aug. 4.

Both drugs, Dr. Bunim said, on the basis of relatively short term trials appear to be more satisfactory anti-rheumatic agents than any other compounds thus far known. They are effective anti-rheumatic and anti-inflammatory agents.

They are three to four times more potent than cortisone and two to three times more potent than hydrocortisone. Observations indicate this higher potency is not accomplished by increased side effects. In fact, the reverse is true.

The increased potency makes possible a smaller dose. The dose is sufficient to control the arthritis satisfactorily and yet small enough to avoid undesirable side effects. In this way, the new drugs are able to demonstrate a higher therapeutic ratio than cortisone and also hydrocortisone.

Although the drugs as yet have not caused any of the undesirable side effects common to cortisone, it is not as yet known whether they will in time show some of the limitations of the hormone.

For example, it is yet to be demonstrated whether prolonged use of the drugs will develop a tolerance to them or any side effects not as yet apparent.

Neither of these drugs, Dr. Bunim said, is a cure for arthritis, nor are they completely satisfactory; certainly not good enough to encourage complacency.

All that can be said at this point is that on the basis of these short-term trials on a limited number of patients

these new steroids appear to be better than anything else now available.

Dr. Bunim in these trials was assisted by Dr. Alfred J. Bollet, also of the National Institute of Arthritis and Metabolic Diseases, and by Dr. Maurice M. Pechet of the National Heart Institute.

Vitamin-Hormone Drug Checks Distemper

▶ DISTEMPER in dogs can be checked by a drug that combines a massive dose of anti-anemia vitamin B-12 and the anti-arthritis pituitary gland hormone, ACTH.

This good news for dog owners appears in an announcement from the Armour Veterinary Laboratories in Chicago.

No one knows yet why this vitamin-hormone combination works. Studies are now under way to find this out. But in tests on more than 600 dogs, the drug has stopped distemper in its course, in most cases, both in the acute stage and in the late, usually fatal, spinal cord complications. In animals recovered from acute distemper under orthodox treatment, it has exerted a prophylactic effect on the late complications.

The formula was invented and developed by the staff of the Armour Veterinary Laboratories. Under the name ACB-12, it is now going on the market to licensed veterinarians.

Most dog owners protect their animals against distemper by having them vaccinated while still puppies. But for those who do not, the new drug should be a valuable aid.

Canine distemper is a virus infection which first runs an acute course, then, after a symptom-free period of one to three weeks, reappears in the form of various complications which indicate an attack on the motor areas of the spinal cord. About 50% of dogs which recover from the initial acute attack show the central nervous system involvement later.

Reports compiled from various veterinary hospitals to date show that in acute distemper 73% of the dogs treated recovered, while 17% were improved, and 10% remained unaffected.

In posterior paralysis 85% of 211 dogs recovered, 8% were improved and 7% unaffected.

Non-Rusting Plating Can be Soldered

▶ AN INEXPENSIVE rust-resisting coating that can be soldered is produced by a new plating process described to the Electrochemical Society by E. B. Saubestre of Sylvania Electric Products Physics Laboratory at Bayside, N. Y.

Called zincaloy, it has the corrosion protection of zinc and the solderability of tin or cadmium at a price only slightly greater than that of zinc. A new type of plating solution was developed and a procedure for operating with soluble alloy anodes was achieved. The bath used combines tin and zinc plating solution in an unusual manner.

Scientist and Artist Struggle For Partial Order in Total Chaos

Prospects in the Arts and Sciences

by J. Robert Oppenheimer

The following talk of J. Robert Oppenheimer, Director of the Institute for Advanced Study, Princeton, New Jersey, concluded the second Columbia University Bicentennial radio series presented by the Columbia Broadcasting System during 1954. The thirteen programs of this series dealt with "Present Knowledge and New Directions."

➤ The words "prospects in the arts and sciences" mean two quite different things to me. One is prophecy: what will the scientist discover and the painter paint, what new forms will alter music, what parts of experience will newly yield to objective description? The other meaning is that of a view: what do we see, when we look at the world today, and compare it with the past? I am not a prophet; and I cannot very well speak to the first subject, though in many ways I should like to. I shall try to speak to the second, because there are some features of this view which seem to me so remarkable, so new and so arresting, that it may be worth turning our eyes to them; it may even help us to create and shape the future better, though we cannot foretell it.

In the arts and in the sciences, it would be good to be a prophet. It would be a delight to know the future. I had thought for a while of my own field of physics and of those nearest to it in the natural sciences. It would not be too hard to outline the questions which natural scientists today are asking themselves and trying to answer. What, we ask in physics, is matter, what is it made of, how does it behave when it is more and more violently atomized, when we try to pound out of the stuff around us, the ingredients which only violence creates and makes manifest. What, the chemists ask, are those special features of proteins which make life possible and give it its characteristic endurance and mutability? What subtle chemistry, what arrangements, reactions and controls make the cells of living organisms differentiate so that they may perform functions as oddly diverse as transmitting information throughout our nervous systems or covering our heads with hair. What happens in the brain to make a record of the past, to hide it from consciousness, to make it accessible to recall? What are the physical features which make consciousness possible.

The Pressing Questions

All history teaches us that these questions that we think the pressing ones will be transmuted before they are answered, that they will be replaced by others, and that the very process of discovery will shatter the concepts that we today use to describe our puzzlement.

It is true that there are some who profess to see in matters of culture, in matters precisely of the arts and sciences, a certain macro-historical pattern, a grand system of laws which determines the course of civilization

and gives a kind of inevitable quality to the unfolding of the future. They would, for instance, see the radical, formal experimentation which characterized the music of the last half century as an inevitable consequence of the immense flowering and enrichment of natural science; they would see a necessary order in the fact that innovation in music precedes that in painting and that in turn in poetry, and point to this sequence in older cultures. They would attribute the formal experimentation of the arts to the dissolution, in an industrial and technical society, of authority, of secular, political authority, and of the catholic authority of the church. They are thus armed to predict the future. But this, I fear, is not my dish.

What the World Looks Like

If a prospect is not a prophecy, it is a view. What does the world of the arts and sciences look like? There are two ways of looking at it: One is the view of the traveller, going by horse or foot, from village to village to town, staying in each to talk with those who live there and to gather something of the quality of its life. This is the intimate view, partial, somewhat accidental, limited by the limited life and strength and curiosity of the traveller, but intimate and human, in a human compass. The other is the vast view, showing the earth with its fields and towns and valleys as they appear to a camera carried in a high altitude rocket. In one sense this prospect will be more complete; one will see all branches of knowledge, one will see all the arts, one will see them as part of the vastness and complication of the whole human life on earth. But one will miss a great deal; the beauty and warmth of human life will largely be gone from that prospect.

It is in this vast high altitude survey that one sees the general surprising quantitative features that distinguish our time. This is where the listings of science and endowments and laboratories and books published show up; this is where we learn that more people are engaged in scientific research today than ever before, that the Soviet world and the free world are running neck and neck in the training of scientists, that more books are published per capita in England than in the United States, that the social sciences are pursued actively in America, Scandinavia and England, that there are more people who hear the great music of the past, and more music composed and more paintings painted. This is where we learn that the arts and sciences are flourishing. This great map, showing the world from afar and almost as to a stranger, would show more: it would show the immense diversity of culture and life, diversity in place and tradition for the first time clearly manifest on a worldwide scale, diversity in technique and language, separating science from science and art from art, and all of one from all of the other. This great map, worldwide, culture-wide, remote, has some odd features. There are innumerable villages. Between the villages there appear to be almost no paths discernible from this high altitude. Here and there, passing near a village, sometimes through its heart, there will be a sort of superhighway, along which windy traffic moves at enormous speed. The superhighways seem to have little connection with villages, starting anywhere, ending anywhere, and sometimes appearing

almost by design to disrupt the quiet of the village. This view gives us no sense of order or of unity. To find these we must visit the villages, the quiet, busy places, the laboratories and studies and studios. We must see the paths that are barely discernible; we must understand the superhighways, and their dangers.

Heroic Days in Science

In the natural sciences these are, and have been, and are likely to continue to be, heroic days. Discovery follows discovery, each both raising and answering questions, each ending a long search, and each providing the new instruments for a new search. There are radical ways of thinking unfamiliar to common sense and connected with it by decades or centuries of increasingly specialized and unfamiliar experience. There are lessons so limited, for all its variety, the common experience of man has been with regard to natural phenomenon, and hints and analogies as to how limited may be his experience with man. Every new finding is a part of the instrument kit of the sciences, for further investigation and for penetrating into new fields. Discoveries of knowledge fructify technology and the practical arts, and these in turn pay back refined techniques, new possibilities of observation and experiment.

Harmony Among Scientists

In any science there is harmony between practitioners. A man may work as an individual, learning of what his colleaguese do through reading or conversation; he may be working as a member of a group on problems whose technical equipment is too massive for individual effort. But whether he is a part of a team or solitary in his own study, he, as a professional, is a member of a community. His colleagues in his own branch of science will be grateful to him for the inventive or creative thoughts he has, will welcome his criticism. His world and work will be objectively communicable; and he will be quite sure that if there is error in it, that error will not long be undetected. In his own line of work he lives in a community where common understanding combines with common purpose and interest to bind men together both in freedom and in cooperation.

This experience will make him acutely aware of how limited, how inadequate, how precious is this condition of his life; for in his relations with a wider society, there will be neither the sense of community nor of objective understanding. He will sometimes find, in returning to practical undertakings, some sense of community with men who are not expert in his science, with other scientists whose work is remote from his, and with men of action and men of art. The frontiers of science are separated now by long years of study, by specialized vocabularies, arts, techniques and knowledge from the common heritage even of a most civilized society; and anyone working at the frontier of such science is in that sense a very long way from home, a long way too from the practical arts that were its matrix and origin, as indeed they were of what we today call art.

The specialization of science is an inevitable accompaniment of progress; yet it is full of dangers, and it is cruelly wasteful, since so much that is beautiful and enlightening is cut off from most of the world. Thus it is proper

to the role of the scientist that he not merely find new truth and communicate it to his fellows, but that he teach, that he try to bring the most honest and intelligible account of new knowledge to all who will try to learn. This is one reason—it is the decisive organic reason—why scientists belong in universities. It is one reason why the patronage of science by and through universities is its most proper form; for it is here, in teaching, in the association of scholars, and in the friendships of teachers and taught, of men who by profession must themselves be both teachers and taught, that the narrowness of scientific life can best be moderated, and that the analogies, insights and harmonies of scientific discovery can find their way into the wider life of man.

Artist and Scientist

In the situation of the artist today there are both analogies and differences to that of the scientist; but it is the differences which are the most striking, and which raise the problems that touch most on the evil of our day. For the artist it is not enough that he communicate with others who are expert in his own art. Their fellowship, their understanding and their appreciation may encourage him; but that is not the end of his work, nor its nature. The artist depends on a common sensibility and culture, on a common meaning of symbols, on a community of experience and common ways of describing and interpreting it. He need not write for everyone or paint or play for everyone. But his audience must be man; it must be man, and not a specialized set of experts among his fellows. Today that is very difficult. Often the artist has an aching sense of loneliness, for the community to which he addresses himself is largely not there; the traditions and the culture, the symbols and the history, the myths and the common experience, which it is his function to illuminate, to harmonize and to portray, have been dissolved in a changing world.

There is, it is true, an artificial audience maintained to moderate between the artist and the world for which he works: the audience of the professional critics, popularizers, and advertisers of art. But though, as does the popularizer and promoter of science, the critic fulfills a necessary present function, and introduces some order and some communication between the artist and the world, he cannot add to the intimacy and the directness and the depth with which the artist addresses his fellow men.

To the artist's loneliness there is a complementary great and terrible barrenness in the lives of men. They are deprived of the illumination, the light and tenderness and insight of an intelligible interpretation, in contemporary terms, of the sorrows and wonders and gayeties and follies of man's life. This may be in part offset, and is, by the great growth of technical means for making the art of the past available. But these provide a record of past intimacies between art and life; even when they are applied to the writing and painting and composing of the day, they do not bridge the gulf between a society too vast and too disordered, and the artist trying to give meaning and beauty to its parts.

In an important sense, this world of ours is a new world, in which the unity of knowledge, the nature of human communities, the order of soci-

ety, the order of ideas, the very notions of society and culture have changed, and will not return to what they have been in the past. What is new is new not because it has never been there before, but because it has changed in quality. One thing that is new is the prevalence of newness, the changing scale and scope of change itself, so that the world alters as we walk in it, so that the years of man's life measure not some small growth or rearrangement or moderation of what he learned in childhood, but a great upheaval. What is new is that in one generation our knowledge of the natural world engulfs, upsets and complements all knowledge of the natural world before. The techniques, among which and by which we live, multiply and ramify, so that the whole world is bound together by communications, blocked here and there by the immense synapses of political tyranny. The global quality of the world is new: our knowledge of and sympathy with remote and diverse peoples, our involvement with them in practical terms and our commitment to them in terms of brotherhood. What is new in the world is the massive character of the dissolution and corruption of authority, in belief, in ritual and in temporal order. Yet this is the world that we have come to live in. The very difficulties which it presents derive from growth in understanding, in skill, in power. To assail the changes that have unmoored us from the past is futile, and in a deep sense I think it is wicked. We need to recognize the change, and learn what resources we have.

Again I will turn to the schools, and as their end and as their center, the universities. For the problem of the scientist is in this respect not different from that of the artist, nor of the historian. He needs to be a part of the community; and the community can only with loss and peril be without him. Thus it is with a sense of interest and hope that we see a growing recognition that the creative artist is a proper charge on the university, and the university a proper home for him: that a composer or a poet or a playwright or painter needs the toleration, understanding, the rather local and parochial patronage that a university can give; and that this will protect him from the tyranny of man's communication and professional promotion. For here there is an honest chance that what the artist has of insight and of beauty will take root in the community, and that some intimacy and some human bonds can mark his relations with his patrons. For a university rightly and inherently is a place where the individual man can form new syntheses, where the accidents of friendship and association can open a man's eyes to a part of science or art which he had not known before, where parts of human life, remote and perhaps superficially incompatible, can find in men their harmony and their synthesis.

These then, in rough and rather general words, are some of the things we see as we walk through the villages of the arts and of the sciences, and notice how thin are the paths that lead from one to another, and how little in terms of human understanding and pleasure the work of the villages comes to be shared outside.

The superhighways do not help. They are the mass media—from the

loud speakers in the deserts of Asia Minor and the cities of Communist China, to the organized professional theatre of Broadway. They are the purveyors of art and science and culture for the millions upon millions—the promoters who represent the arts and sciences to humanity and who represent humanity to the arts and sciences; they are the means by which we are reminded of the famine in remote places or of war or trouble or change; they are the means by which this great earth and its peoples have become one to one another, the means by which the news of discovery or honor, and the stories and songs of today travel and resound throughout the world. But they are also the means by which the true human community, the man knowing man, the neighbor understanding neighbor, the school boy learning a poem, the women dancing, the individual curiosity, the individual sense of beauty are being blown dry and issueless, the means by which the passivity of the disengaged spectator presents to the man of art and science the bleak face of unhumanity.

Bonds and Barriers

For the truth is that this is indeed inevitably and increasingly an open, and inevitably and increasingly an eclectic world. We know too much for one man to know much, we live too variously to live as one. Our histories and traditions—the very means of interpreting life—are both bonds and barriers among us. Our knowledge separates as well as it unites; our orders disintegrate as well as bind; our art brings us together and sets us apart. The artist's loneliness, the scholar despairing, because no one will any longer trouble to learn what he can teach, the narrowness of the scientist, these are not unnatural inertia in this great time of change.

For what is asked of us is not easy. The openness of this world derives its character from the irreversability of learning; what is once learned is part of human life. We cannot close our minds to discovery, we cannot stop our ears so that the voices of far off and strange people can no longer reach them. The great cultures of the East cannot be walled off from ours by impassible seas and defects of understanding based on ignorance and unfamiliarity. Neither our integrity as men of learning, nor our humanity allows that. In this open world, what is there any man may try to learn.

The Course of Freedom

This is no new problem. There has always been more to know than one man could know; there have always been modes of feeling that could not move the same heart; there have always been deeply held beliefs that could not be composed into a synthetic union. Yet never before today has the diversity, the complexity, the richness so clearly defied hierarchical order and simplification, never before have we had to understand the complementary, mutually not compatible ways of life, and recognize choice between them as the only course of freedom. Never before today has the integrity of the intimate, the detailed, the true art, the integrity of craftsmanship and the preservation of the familiar, of the humorous and the beautiful stood in more massive contrast to the vastness of life, the greatness of the globe, the otherness of people, the otherness of ways, and the all encompassing dark.

This is the world in which each of us, knowing his limitations, knowing the evils of superficiality and the terrors of fatigue, will have to cling to what is close to him, to what he knows, to what he can do, to his friends and his tradition and his love, lest he be dissolved in a universal confusion and know nothing and love nothing. It is at the same time a world in which none of us can find hieratic prescription or general sanction for any ignorance, any insensitivity, any indifference. When a friend tells us of new discovery we may not understand, we may not be able to listen without jeopardizing the work that is ours and closer to us; but we cannot find in a book or canon—and we should not seek—grounds for hallowing our ignorance. If a man tells us that he sees differently than we or that he finds beautiful what we find ugly, we may have to leave the room, from fatigue or trouble; but that is our weakness and our default. If we must live with a perpetual sense that the world and the men in it are greater than we and too much for us, let it be the measure of our virtue that we know this and seek no comfort. Above all let us not proclaim that the limits of our powers correspond to some special wisdom in our choice of life, of learning or of beauty.

A Precarious Balance

This balance, this perpetual, precarious impossible balance between the infinitely open and the intimate, this time — our 20th Century — has been long in coming; but it has come. It is, I think, for us and our children, our only way.

This is for all men. For the artist and for the scientist there is a special problem and a special hope, for in their extraordinarily different ways, in their lives that have increasingly divergent character, there is still a sensed bond, a sensed analogy. Both the man of science and the man of art live always at the edge of mystery, surrounded by it; both always, as the measure of their creation, have had to do with the harmonization of what is new with what is familiar, with the balance between novelty and synthesis, with the struggle to make partial order in total chaos. They can, in their work, and in their lives help themselves, help one another and help all men. They can make the paths that connect the villages of arts and sciences with each other, and with the world at large, the multiple, varied, precious bonds of a true and worldwide community.

A Rugged Time

This cannot be an easy life. We shall have a rugged time of it, to keep our minds open and to keep them deep, to keep our sense of beauty and our ability to make it, and our occasional ability to see it in places remote and strange and unfamiliar; we shall have a rugged time of it, all of us, in keeping these gardens in our villages, in keeping open the manifold, intricate, casual paths, to keep these flourishing in a great open windy world; but this, as I see it, is the condition of man; and in this condition we can help, because we can love, one another.

A "look" from a pair of electronic eyes is all it takes to measure the width of red hot steel strips moving through rolling mills.

Long staple cotton is considered excellent when the fibers grow two and one-half inches long.

New Starch Better For Plastics and Fibers

New Corn Hybrid Makes New Starch

A SPECIAL kind of cornstarch from a new corn hybrid has possibilities for future use in cellophane-like films, fibers and plastics, the American Chemical Society was told at its recent meeting.

The special starch, amylose, has a thread-like molecular structure, and its basic chemical make-up is beginning to become clear, Dr. Ivan A. Wolff of the U. S. Department of Agriculture's Northern Utilization Research Branch, Peoria, Ill., told the Society's Division of Carbohydrate Chemistry.

Ordinary cornstarch—the kind that makes pastes, puddings and adhesives—has a branched structure. Most corn varieties yield starch made up chiefly of the branched molecules, and separation of the small fraction containing straight molecules is difficult and expensive.

But new corn hybrids now have been developed that yield high quantities of starch containing up to 60 per cent of the straight-molecule, film forming amylose variety that may prove useful in plastics and similar applications, Dr. Wolff reported.

Detailed studies of amylopectin—the important insoluble component of amylose starch—obtained from one of the new hybrids showed that it is a new type. Its chain-like molecule proved to be about one-third longer than the molecules of amylose starch obtained in small quantities from ordinary corn, Dr. Wolff said. The special properties of the film-forming starch may be linked to this extra molecular length, he reported, but further detailed study of its chemical structure is necessary before its industrial possibilities can be exploited.

The success which has been achieved in the production of superior corn by the development of suitable hybrids is now well known and attested by the fact that in 1952 about 85 per cent of the total corn acreage in the United States was planted with hybrid seed, Dr. Wolff said. The most important factors considered by plant breeders in developing these hybrids were such things as yield per acre, height and appearance, resistance to certain diseases, time required to reach maturity, and the like. It is of interest now to go one step further and to attempt to develop corn varieties which have the desired composition with respect to one or more given constituents.

The Northern Utilization Research Branch has been cooperating in work along this line with a number of plant breeders, explained Dr. Wolff, an organic chemist, who is head of the starch conversion unit at Peoria. Co-authors of his paper were B. T. Hofreiter, P. R. Watson, W. L. Deatherage and M. M. MacMasters.

For the Home Lab

Organic Reactions: Halogenation

(Part I)

by Burton L. Hawk

➤ Halogenation is the process of adding a halogen to an organic compound. Depending on the halogen used, the process can be a chlorination, bromination, iodination, or fluorination reaction.

The introduction of fluorine in organic compounds is a relatively new field which promises to reveal many interesting and useful compounds. One example is the widely used refrigerant, "freon", (dichlorodifluoromethane) which is made by the action of antimony trifluoride on carbon tetrachloride.

Iodine does not render itself so readily for hydrogenation as the other halogens. The most important iodine compound is *iodoform*, obtained by the iodination of acetone or alcohol.

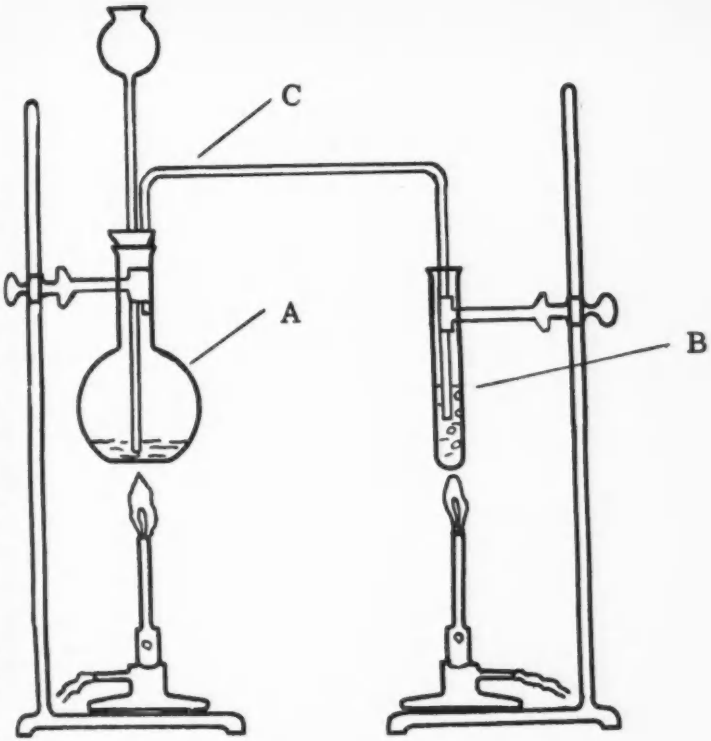
Bromine is very similar to chlorine in its reactions with organic compounds. It is used more in the laboratory because of the convenience of its physical state. *Bromobenzene* is an important bromine compound made by the bromination of benzene.

Chlorine is by far the most popular halogenating agent. It is active, easily prepared, economical, and forms many useful compounds. Among the compounds obtained are carbon tetrachloride, chloroform, ethyl chloride, chloral, chlorobenzene, etc.

Right now we will concern ourselves with chlorination. Chlorination can be performed by a variety of methods. One method is by using chlorine itself. A good example of this method is the formation of chloral from ethyl alcohol.

First of all, remember that chlorine is quite poisonous and very irritating to the mucous membranes. Perform this experiment with adequate ventilation and avoid inhaling the gas.

Arrange an apparatus as shown in the accompanying diagram. Place 2 or 3 grams of maganese dioxide in flask A and pour 5 cc. of hydrochloric acid on top of it through the thistle tube. Place 5 cc. of *warm* ethyl alcohol in test tube B. Add a small piece of iron, such as a tack, to the alcohol. This acts as a catalyst, or *halogen carrier*. Heat the flask until a steady flow of chlorine is produced. Allow it to bubble through the alcohol for a few minutes. Then apply gentle heat to the alcohol, gradually increasing until it just begins to boil. Continue to bubble the chlorine through the gently boiling alcohol for about 10 or 15 minutes. Do not allow the alcohol to boil too vigorously, or you will lose most of it by evaporation. Several compounds are formed during this reaction, with chloral as the final product. Commercially, the chloral is separated by distillation with sulfuric acid. It dissolves in water to form chloral hydrate which is used in medicine as a sedative and hypnotic. When chloral hydrate is heated with sodium hydroxide solution, chloroform is obtained. When either chloral or the



Basic apparatus for halogenation reactions

hydrate is condensed with chlorobenzene, DDT is obtained.

The direct chlorination of carbon disulfide by the above method produces carbon tetrachloride. However, we do *not* recommend this reaction for the home laboratory.

Hydrogen chloride can also be used as a chlorinating agent. The halogenation of turpentine to form bornyl chloride ("pinene hydrochloride") is one example. With slight modification, you can use the same apparatus as in the chloral preparation. Remove the thistle tube and replace with a thermometer. Insert tube B in a container of ice water. Place about 10 cc. of good quality turpentine in the flask and distil. Collect that portion which boils over at 154 to 156 degrees. Now rearrange your apparatus again. Remove the thermometer and reinsert

the thistle tube. Clean flask A thoroughly and add 10 cc. of con. hydrochloric acid. Insert a drying tube, filled with calcium chloride, to the apparatus at point C. Heat flask A gently and allow the hydrogen chloride gas to bubble through the freshly distilled turpentine immersed in a container of ice water. When the turpentine is saturated with HCl gas, disconnect the apparatus. Add water to the product and white particles of bornyl chloride will separate out of solution. This is sometimes referred to as "artificial camphor". Note its odor. (For more details on this reaction, see "Artificial Camphor", CHEMISTRY, November, 1952).

Chlorination can also be carried out by using sodium hypochlorite as the agent. A good example of such a reaction is the halogenation of acetone to obtain chloroform. Add 5 grams of sodium hypochlorite (or bleaching powder) to 20 cc. of water in a flask and stir thoroughly. Then add, in small portions, a mixture of 1 cc. of acetone with 3 cc. of water. Shake thoroughly after each addition. Now, again you can use the same apparatus set-up. Remove the thistle tube and insert a one-hole stopper in the flask with only tube C attached. (The drying tube may be removed). Heat gently. Chloroform will distil over and condense in tube B, which should be immersed in ice water.

Chemical May Make Burns Hurt

➤ A CHEMICAL that could be the stuff that makes burns and blisters hurt has been discovered in blood plasma.

The chemical was discovered by Drs. Desiree Armstrong, C. A. Keele, J. B. Jepson and J. W. Stewart of Middlesex Hospital Medical School, London.

They call the chemical "pain-producing substance." They have not yet been able to isolate it in pure form nor to determine its chemical make-up, but it probably is a polypeptide.

When blood plasma escapes from the tiny blood vessels called capillaries, the pain-producing substance might develop and cause pain when it makes contact with damaged tissues, as in burns, the scientists suggest.

They are at present studying its role in the production of pain due to burns and other disease conditions.

When applied to the exposed base of a blister, the chemical produces pain but does not cause itching, flare or wheal. In addition to this action, it causes contraction of the rat uterus when removed from the animal's body.

The chemical does not develop in plasma if contact with glass and metal is avoided in the collection of the blood and separation of the plasma. But it does develop within a few minutes after the plasma is transferred to a glass tube. Its activity reaches a peak within 10 minutes and decays to one-tenth or one-twentieth of peak value in an hour.

New Dictionary To Save Lives

Household Chemicals Can be Deadly

➤ THE IDEA of a dictionary saving lives may seem odd. But that is what is expected from a new dictionary now in preparation by a team of researchers at the University of Rochester (N.Y.) School of Medicine and Dentistry. The lives to be saved through this dictionary will be those that might otherwise be lost through accidental poisoning.

It will be the first complete medical directory of trademarked and generally known products which might be involved in accidental poisoning in the home. The book will list products; their hazardous ingredients, if any; the degree of damage to be expected from swallowing them accidentally, and what to do about it.

Dr. Harold C. Hodge, professor of pharmacology and toxicology, and Marion Gleason, a research associate, have been working on the project for over four years. They have collected and analyzed data on about 15,000 products which will form the bulk of the dictionary's contents.

In recent years, chemical science has added in a rapidly expanding manner thousands of new substances which are the basis of our standard of living, Dr. Hodge notes, and points out that anything from aspirin to zuccini can be poisonous for certain people under certain conditions. No doctor can be familiar with more than a few of the possibilities.

The Rochester researchers have sought to collect complete data on every chemical product used in housekeeping and hobbies, including cleaning, polishing, gardening, stamp collecting, painting, motor boating and craft work.

The research has involved them in the closely-related study of the medical aspects of accident control. This study includes an investigation of hidden physical disorders not commonly detected by physicians attending accident cases, accident-predisposing drugs and medications, and chemicals whose fumes can be accident predisposing.

Accident Fighters

➤ CHEMICALS used in many households for such everyday tasks as cleaning, heating and insect killing are just as deadly as the poisons produced by plague bacilli and other disease germs, Dr. Edward Press of the University of Chicago and Dr. Robert B. Mellins of the U.S. Public Health Service Communicable Disease Center charge. Dr. Mellins is on loan to the Chicago Board of Health.

These and other causes of accidental deaths and injuries should be fought by health and medical authorities in the same way that epidemics of disease are fought, Drs. Press and Mellins and other scientists declared at a meeting of the American Public Health Association.

The major threats to early death formerly made by epidemics of smallpox, cholera, and plague are now being replaced by accidental injury and

poisoning; and by the traumatic and radiation hazards of nuclear energy, Drs. Press and Mellins declared.

The same machine age responsible through its advances in sanitation, immunization, chemotherapy and antibiotics for controlling the damage done by the toxins and toxic products generated by the germs that caused the above epidemics has, by similar advances, posed new threats to life and health.

Toxins and toxic products with results just as lethal as those elaborated by the bacteria causing plague and similar scourges are now synthesized by modern industry for household uses. This results in making them available for use and for deadly misuse in almost every home. The same modern industry responsible for manufacturing millions of doses of vaccine in a short period is now making millions of automobiles as well as airplanes, atom bombs and other wholesale hazards to life and limb.

To fight the poisoning hazard, a poisoning control program has been set up by hospitals in Chicago and the Chicago Board of Health. Medical societies and the Illinois State Toxicological Laboratory are cooperating.

The hospitals have been furnished a specially prepared outline guide for treating poisoning victims. Careful records and follow-up visits to patients' homes through the board of health are other features of the educational, treatment and prevention program.

Boston, Cincinnati, Dallas, New York City, Phoenix and Washington, D.C., have now begun operating or are about to start operating similar poisoning control programs.

In New York City the Bureau of Child Health is, in addition, following up all accidents to children under six years. From records being accumulated it is hoped that better preventive measures can be developed. Meanwhile, health department nurses carry the accident prevention lesson to all homes where a small child has suffered an accident.

This program was reported by Dr. Harold Jacobziner, assistant commissioner, Miss Patricia I. Heely, director of the bureau of public health nursing, and senior statistician Herbert Rich, all of the New York City Department of Health.

A "What's Your Answer" quiz distributed to PTA members throughout the state has been a powerful tool in New Jersey's accident prevention program, Dr. Renee Zindwer of the state's Department of Health reported.

The quiz gives typical home situations involving potential danger to a small child and four possible solutions of each problem. In the course of picking the right solution, those taking the quiz get involved emotionally and therefore take part more eagerly and effectively in the push to prevent accidents.

Nearly half the aluminum made in America is produced in the North Pacific states because of available electricity from hydroelectric plants.

A new cast aluminum alloy containing nickel and copper can be used at higher temperatures than standard aluminum alloys.

Protect Against Degradation By Ultraviolet Radiation

Chemicals Absorb U. V. Harmlessly

Reprinted from FOR INSTANCE, *American Cyanamid Company.*

➤ ELECTROMAGNETIC energy is a natural wonder which manifests itself in many different but related forms. The most obvious forms are light and heat from the sun but there are many others in the entire energy spectrum.

They include such familiar phenomena as ultraviolet radiation, x-rays, cosmic rays, and the electric waves used in radar, television, and power transmission.

When these various forms of energy are described in terms of waves they will be found to be related and to present a continuous series varying only in wave length.

The very shortest ones are cosmic rays, four million million to one inch, and the longest are electric waves slightly more than 3,000 miles each.

Man has used these forms of energy to "see" the arrangement of atoms in a crystal or the bones in his body, to view distant events on a screen at home, to send his voice around the world, and to distribute millions of horse power to farms and industry.

Ultraviolet (U.V.) radiation is shorter in wavelength than visible light and has greater penetrating power. Sunlight contains from 3% to 5% of U.V. which is largely responsible for the tan we develop when exposed to sunshine.

U.V. is a major cause of many degrading effects such as fading of certain dyes, discoloration and embrittlement of clear lacquers and some plastics, and many other effects which are not seen so readily.

When U.V. radiation strikes a material it may pass through it completely, it may be absorbed completely, or it may be partly transmitted and partly absorbed.

If U.V. passes through a material completely, no harm is done. However, some materials are not harmed even when they absorb U.V. almost completely.

Frequently, this type of U.V. absorber may be used to protect other materials which are degraded by U.V.

This situation prompts the question, "Why does absorbed U.V. harm some materials and not others?"

Since U.V. is a form of energy it can either do work or be changed into another form of energy. The work may change the chemical or physical structure of the molecules of a material and so change its properties for better or for worse.

The U.V. may be converted into another form of energy such as light and be re-emitted; this occurs when certain materials fluoresce if exposed to U.V. or "black light."

The absorbed U.V. also may be converted into harmless heat and be dissipated without doing any damage. The last possibility applies to those unique materials which absorb prac-

tically all of the harmful U.V. in sunlight and are not damaged by it.

A group of compounds known to chemists as substituted benzophenones are efficient U.V. absorbers.

In particular, the 2-hydroxy-4-methoxy benzophenone, sold as U.V. Absorber 9, is unusually effective in protecting a wide range of materials. Other members of the group also are available for experimental purposes.

The "ounce of prevention" which is so much better than a "pound of cure" is pertinent to U.V. absorbers.

They may be used to inhibit discoloration and embrittlement of clear lacquers, plastics, and textiles, retard fading of dyes and protect sensitive chemicals, foodstuffs, and other materials.

Glass Bonded to Plastic For Airplanes

➤ AIRPLANE bodies, boats and automobiles in the near future may be made of g'ass and plastic chemically bonded together, experts from the U.S. Naval Ordance Laboratory, Silver Spring, Md., predict.

Five new bonding compounds, which all belong to the class known as chlorosilanes, have been developed to combine with the different types of plastics. They were described at a recent meeting of the American Chemical Society by their designers, Dr. Porter W. Erickson, Dr. H. A. Perry Jr. and Irving Silver. Part of each of the new compounds will unite chemically with one of the plastic materials while another part will join the structure of glass.

Chemical bonding joins the plastic and glass more solidly than the usual glues and cements. The bonded materials form laminated panels which hold together through repeated test folding, showing that the finished material combines plastic's flexibility with the strength of the glass fibers.

Catalytic Cracking Coolest but Plenty Hot

➤ CATALYTIC cracking of gasoline, although carried on at a lower temperature than conventional thermal cracking, has plenty of heat to start a fire if combustible gases escape. Such a leak may have started some fires in gasoline refineries.

In the catalytic refining process, which chemists refer to as "cat" cracking, oil is changed to gas by heating under pressure to about 880 degrees F. It is then passed over clay baffle plates, which help to change the product into compounds closer to the ideal gasoline. Sulfur, which is especially high in the western oils, is taken out during this process.

Two catalyzing chambers are used in the catalytic process. The gas is treated alternately in each. The carbon removed during one cycle is burned off while the petroleum is being treated in the other. Heat from burning out the carbon is used for power to operate the plant.

Harnessing Energy Like That Generated in the Stars

The Savannah River Project

by GRANVILLE M. READ

Extract from a speech made by the chief engineer of E. I. du Pont de Nemours & Co. before the Rotary Club of Wilmington, Delaware, in which he describes the scientific and technical factors the company had to take into account in building the new atomic installation for producing A-bomb and H-bomb materials.

▸ TO UNDERSTAND what we were undertaking, let's go back some 60 years. In 1896 Becquerel discovered in France that uranium salts emitted a new form of energy. Two years later Madam Curie and her husband found that pitchblende, a uranium ore, contained a much more powerful source of this energy which they isolated. It is now known as radium. Madam Curie called this new form of energy radioactivity. The work of Henri Becquerel and the Curies marked the beginning of the atomic age. The next big step was the announcement by Albert Einstein of his theories of relativity, and the concept that mass and energy are equivalent, with the one changing into the other under given conditions. Einstein suggested this might explain the phenomenon of radioactivity.

There was little further scientific development until after the First World War, when scientists obtained experimental evidence of the basic composition of the atom and the magnitude of its potential energy. This mighty midget, the atom, had at last been captured, but it was by no means submissive to its captors.

Enrico Fermi, an eminent Italian scientist, was the first to fission uranium while conducting a series of neutron bombardment experiments. He was unaware of his achievement until later when two German chemists, Strassman and Hahn, proved that Fermi had split the atom. A few years later, Fermi discovered that this fission produced excess neutrons, which in turn would combine with more uranium to produce a chain reaction. This principle was used to produce plutonium for use in the A-bomb.

The First Chain Reaction

The confirmation of Fermi's concept took place in 1942 under the University of Chicago stadium. There the first small carbon uranium pile was constructed, the forerunner of the plutonium production unit at Hanford. It was there that Du Pont first entered the atomic picture by having scientific representation present during the work.

The purpose of the Chicago experiment was to determine whether a chain reaction would take place in a carbon pile, and it did. But this experiment might be compared to Benjamin Franklin's discovery of atmospheric electricity with a kite, a string, and a key. Lucky old Ben didn't have to design, construct and operate a plant based on his simple findings. The Manhattan District of the U. S.

Army, a unit specifically set up by order of President Roosevelt, requested Du Pont to build an atomic plant based on a minute amount of atomic engineering details, in the shortest possible time. The company's role was the orchestration of this new scientific knowledge into a playable symphony.

Thanks to the maestros, the various orchestra sections, and many soloists, who all played their parts earnestly and well, the first use of the atomic bomb was successful, saved the lives of hundreds of thousands of American boys by ending the war without an invasion of Japan, and later served as a deterrent to the start of a Third World War.

More Powerful Bomb Sought

Even during the period when the A-bomb was being designed, the scientists were searching for a way to produce one that might be many times—perhaps a hundred or a thousand times—more powerful. This was known as the H-bomb concept. Information has been given out that one obstacle was the problem of obtaining the extremely high temperatures required to ignite and fuse or bring together, under certain conditions, two of the higher isotopes of hydrogen. A lead was found when the A-bomb generated temperatures as high as 50 million degrees Centigrade in one and one-tenth millionths of a second.

Such temperatures in so brief a time period are difficult for the human mind to comprehend. As human beings, we are accustomed to a temperature span from a little below freezing —Centigrade zero—to boiling, which at sea level occurs at 100 degrees Centigrade. As for time measurements, a second elapsed when I uttered the last two words.

The nuclear physicists, however, were no longer earthbound. They had transferred their thinking to the heavens above, and were calculating how to duplicate the reactions of the stars, so as to create on earth—and make available to mankind under controlled conditions—the same sort of energy as that generated in vast amounts in these celestial bodies. This is literally what is now being contemplated in atomic fission.

The sun's temperature, for example, is calculated to be some 20 million degrees Centigrade. It is 93 million miles from the earth. It gives off energy by changing hydrogen to helium at the rate of 564 million tons per second, which is approximately seven million billion times the present rate at which electric power is generated in the United States. Seven million billion is seven followed by 15 zeros. Let us not overlook the sun as a source of future energy for our descendants here below.

Temperature of Fusion

Some scientists by this time had calculated that in some stars the fusion of hydrogen isotopes generated temperatures some ten times that of the sun, and in a much shorter time. It was reasoned that if temperatures of a very high order could be obtained, as recorded in the A-bomb explosion, a fusion reaction could be produced.

So it seemed possible now to trigger a fusion bomb with the atomic bomb. Man had explored the energy of the sun, and bypassed it to explore the source of energy of the stars—some of which, incidentally, in miles away

from the earth are ten thousand times our two hundred and seventy-five billion dollar national debt.

In summary, the A-bomb contains fissionable products of uranium which generate temperatures some 30 million degrees Centigrade higher than the sun. The hydrogen bomb contains fusionable products similar to the stars, and produces temperatures 200 to 400 million degrees Centigrade. And now that you understand perfectly what the H-bomb is, let's go back to earth and find out how the Du Pont Company went about building the plant to make the materials for atomic weapons.

The first step was to delegate responsibility for the project to the Explosives Department, which set up a separate division. All ten of the company's industrial departments contributed top technical and operating personnel to staff this division. With the assistance of universities and Atomic Energy Commission laboratories, the division screened available data and prepared pertinent information for the Engineering Department. This carefully carried-out task had an important bearing on the project's success. The company's auxiliary departments, such as Treasurer's, Legal, Traffic, Purchasing, and Employee Relations, also supplied necessary services. The Executive Committee reviewed and advised on major policies, just as it functions in the commercial operations of the company. The Engineering Department was assigned responsibility for the design and construction of Savannah River, and in turn, subcontracted under its supervision many phases of the work. This was necessary owing to the magnitude of the job and the many highly specialized engineering talents required.

A formidable assignment was the selection of a plant site. The A.E.C. and the Department of Defense had issued certain rigid criteria. The nature of the product established many unusual factors which would be absent in picking a site for an ordinary commercial operation.

Forces of Nature Studied

Broadly and briefly, the site investigation dealt with all the elements and all the forces of nature. It involved:

CLIMATOLOGY, covering river flows, rainfall, floods, and temperatures.

GEOLOGY, covering underground soil foundations, water tables, and underground drainage conditions, and finally, the probability of an earthquake.

METEOROLOGY, covering wind patterns, air currents, storms, intensity of lightning, atmospheric electrical disturbances and their effect on electric power failures.

BIOLOGY, covering plant and marine life and its propagation.

Other cardinal factors included traffic, railways, highways, population surveys, telephone and other communication systems. This information, particularly the climatology and geology, was needed for the design of the heavy structures, the large equipment foundations, reservoirs, powerhouses, anchor blocks, water intake and waste disposal, and many other essentials.

The plant would eventually occupy some 200,000 acres, or about four times the size of the District of Columbia. It would have an electric power

system comparable to the state of Delaware, and water consumption approximating that of Philadelphia.

Some 114 sites were investigated, and in November, 1950, three months after the contract was let, the choice by a joint review committee was an area of South Carolina on the Savannah River, beginning 18 miles southeast of Augusta, Georgia, and 15 miles south of Aiken, S.C.

Atomic Engineering

Meanwhile, we had set up an atomic engineering section completely divorced from commercial work. The key positions were manned by seasoned engineers who were held responsible for design, construction, engineering research and development, fabricating shops and cost control. Their crews were expanded as the work load increased. A small group of "sharp shooters" smoothed out the inevitable differences and reamed out the bottlenecks. Hanford had prepared us to expect the complex problems of Savannah River, and we understood through years of experience what it meant to translate scientific theories into steel and concrete.

It is estimated that some 120 different skills and talents were combined into one technological effort to achieve the final design. We drew upon the scientific talent from all of Du Pont's research laboratories. We drew management, supervision and operating personnel from across the company boards. We used professional consultants in specific fields to make sure we were not missing a bet. In a word, we called on every resource and benefited from every policy established during the Du Pont Company's background of more than a century and a half of industrial growth. This was perhaps the company's greatest contribution to the Savannah River project.

The engineer's job, in a project of this magnitude, is to be the interpreter, to translate basic scientific knowledge into reliable, operatable equipment, and into general plant facilities which can be controlled and maintained by the average trained operator.

Our difficulties in interpretation were multiplied many fold because most materials of construction would be exposed to the new hazard of radiation. In addition to its normal physical properties, equipment had to be selected on the basis of what physical change would take place when it was subjected to various degrees of radiation. Abnormal and unprecedented corrosion and wear conditions had to be anticipated. We had to allow for changes in fiber stress in certain metals.

Radioactive Construction

We knew that all construction materials exposed to radiation would themselves become radioactive, emitting radiation of low intensity even after removal from direct exposure. The severity of this emission falls off according to the half-life of its radioactivity, but never ceases. The half-life is defined as the time required for the initial rate of radioactivity to be reduced 50 per cent, and can be determined by experiment.

There also was the human factor to be considered, for human beings cannot come in contact with radioactivity of high intensity for any appreciable time without harm. This forced us to

design a plant that would be semi-perpetual and automatic in its operation. Such a design goes far beyond the normal economics of construction.

The new word — automation — is normally thought of as a series of continuous, mechanical operations, but at Savannah River it was necessary to go a step further. The newest electronic techniques known were incorporated to monitor and control each phase of the operation.

You see, in a reactor the tremendous potential energy locked up in the atom must be released gradually. This requires controls so sensitive that human operation would be practically impossible. The pulse of the reaction must be taken continuously. The speed of electronic controls is imperative to do this, and also to automatically set in motion the nuclear corrective measures required to compensate for the slightest change.

We might compare the action of an atomic reactor to the sun's release of energy for plant growth. The reactor supplies energy for industrial and military use. Just as growth in nature is silent but continuous, so the reactor is a huge, silent force that goes on continuously, but there is one vast difference. In nature, growth is measured by seasons or years. In the reactor, nuclear growth must be measured in seconds or fractions of seconds if the reaction is to remain under control.

In the design of Savannah River, therefore, all known phases of today's technology were used, and I might add for the record, we came up with a few which did not previously exist.

Dosimeter For Fast Neutrons

▶ FAST NEUTRONS, the most penetrating of all atomic radiations, can be detected by a new, improved pocket-sized radiation indicator developed at the University of California at Los Angeles Atomic Energy Project.

The new dosimeter is an improvement of a previous model designed by Dr. George Taplin and associates which detects various levels of radiation by changes in color of a dye.

It has several advantages, however, over the old model. Not only does it detect fast neutrons, which may penetrate bomb shelters, but it is cheaper to produce and is much more stable in storage.

Chemicals in the new model react almost the same as tissue juices in the body in the absorption of X and gamma rays. They also have a uniform sensitivity to such radiations regardless of penetrating power.

Designed for field operations, the instrument is well suited for the armed forces as well as civil defense. It holds three or more vials filled with a dye solution of aqueous phenol red saturated with trichloroethylene which turns yellow when exposed to radiation. Vials may be set to trip at different doses of radiation ranging all the way from 25 roentgen units (standard measure of radiation exposure) up to hundreds of such units.

Inventors Apply Chemicals To Make Living Comfortable

Patents on Chemical Materials

Order copies of patents by patent number from the Commissioner of Patents, Washington 25, D. C., enclosing 25 cents in coin, money order or Patent Office coupon for each. Do not send stamps.

Floor and Wall Coating

➤ A NEW PLASTIC coating for floors and walls has been created for persons who are unsatisfied with paints, which often wear through, and linoleum, which sometimes is too thick for the job at hand.

The new coating can have asphalt, chlorinated rubber, polystyrene or Vinylite as its film-forming base. It is mixed with water and alcohol before being trowelled to the wall or floor it is to protect.

Annis G. Asaff of Auburndale, Mass., who assigned his patent No. 2,682,517 to Callaghan-Hession Corporation, Boston, reports that the material dries overnight into a hard, waterproof surface that can endure ordinary practical use.

Mold For Steel Castings

➤ A NEW PRECISION shell molding technique has been devised that would permit foundries to cast stainless steel parts in a mold at a temperature of minus 40 to minus 148 degrees Fahrenheit.

As the steel "set," the shell about it would crack off. If all the mold did not break off, the rest could be easily chipped away after the metal cooled, according to Everard F. Kohl of Lakewood, Ohio, who received patent No. 2,682,692 on his molding method.

The new shell molding technique involves freezing a mercury pattern in a semi-permanent mold. The frozen model then would be coated with a thin blanket of a refractory material which would harden quickly even when chilled by the frozen mercury model. For large castings, this shell mold need not exceed one-quarter inch in thickness, the inventor stated.

The mold would be transferred to a special supporting container. The mercury would melt and would be poured out after the blanket about it hardened. Then the mold could be heated to cause a high-temperature binder to cement the mold together, or the mold could be refrigerated. If the latter technique is used, the high-temperature binder would not work, permitting the shell mold to be chipped away easily from the casting.

Drum Carrier For Trucks

➤ FORK-LIFT trucks could handle big drums as easily as heavy boxes if they were equipped with a special clamping mechanism which won patent No. 2,683,546 for Fred Sherriff of Battle Creek, Mich. He assigned his rights to the Clark Equipment Company.

Attached to the lift, the hydraulic clamps can pick up drums lying on their sides, turn them 90 degrees and stack them on end. The clamp assembly has a snug design aimed at per-

mitting big loads to be lifted without danger of toppling the little truck.

Treatment For Molybdenum

➤ A WAY of treating molybdenum with layers of chemical compounds has been worked out to protect the metal from oxidizing, and to keep its molecules from wandering into adjacent metals where they may be attacked by oxygen.

The resulting product becomes more suitable for use as buckets, blades, valves and nozzles in high-temperature gas and steam turbines and jet engines. The protected metal would be able to stand temperatures up to 2,200 degrees Fahrenheit—the point at which molybdenum begins an undesirable recrystallization process.

Claus G. Goetzel of Yonkers, N. Y., assigned his patent, No. 2,683,305, to Sintercast Corporation of America.

Molten Metal Temperature

➤ A METHOD has been worked out that permits foundrymen to take the accurate temperature of molten metal directly as it is tapped from the furnace. It eliminates complicated correction charts.

The method is built around the "black body" system of heat radiation. Molten metal runs through a trough to a special container where it swirls around, forming a vortex. A pyrometer can be sighted into the vortex for a true temperature reading. Sunlight, oxide films on the metal, or slag mixed into it do not affect the temperature reading.

The method was invented by Raymond C. Machler of Philadelphia and William G. Fastie of Willow Grove, Pa. They assigned patent No. 2,683,988 to Leeds and Northrup Company.

Coated Baking Pan

➤ A BAKING PAN coated with vegetable oils and water-repellent silicone resins has been invented to eliminate the "burning in" operation in bakeries. The pre-baking operation has been necessary to make bread loaves brown properly inside the pans.

A thin coating of an alkyd resin containing a small amount of stearine pitch is first applied to the pans. Then silicone resins are brushed over the pan to make the bread loaves come out easily.

Since the stearine pitch is dark, it produces the same bread-browning effect as a "burned in" pan, and it also makes the silicone resins stick better. A test pan was used 150 times without a renewal of the coatings. Pans treated only with silicone resins often require recoating after 75 bakings.

The new coatings were invented by Daniel W. Kennedy of Troy, N. Y., who assigned patent No. 2,684,177 to General Electric Company.

Concrete Dryer

➤ FRESHLY POURED concrete slabs could be hardened in 13 minutes even at temperatures just above freezing by copper electrodes that would be set on the wet pavement. Current would pass from these electrodes through the concrete to reinforcing rods which would act as the receiving electrodes. Heat would be generated and would change some of the water to steam in the concrete, according to Joseph C. Kelly of Linwood, N. J. He received patent No. 2,683,916.

Black Hectograph Ink

➤ A HARD-WEARING black hectograph printing ink won patent No. 2,684,908 for Walter G. Drautz of Glenmont,

N. Y., who assigned it to General Aniline & Film Corporation.

It contains about 45 parts of spirit-soluble Nigrosine which, when added to ink dyes, yields many more copies of the original without deteriorating to bluish, yellowish or reddish shades after the first few copies have been pulled.

The Nigrosine is thought to "assert its influence" to prevent any of the dyes from dominating as the ink breaks down.

Animal Food From Lettuce

➤ WASTE lettuce can be made into a dry meal that can be stored for long periods with the process of James G. Macey of Kentfield, Calif. He assigned patent No. 2,684,903 to Salinas Laboratories, Inc.

The meal contains carotene, protein, B-vitamins, carbohydrates and minerals, and can be used as a feed additive. Mr. Macey says it has a greater feed value than alfalfa because it lacks the toxicity of alfalfa. It also has a lower fiber content than alfalfa.

Lettuce heads, butts and outer leaves are pulverized, blanched, pressed and dried to produce the meal. This waste lettuce, which sometimes is 40% of the western United States crop, heretofore had to be used as a "direct" feed because it would not store.

New Weighing Device

➤ AN ELECTROMAGNETIC weighing device to measure the forces exerted on airplane models in wind tunnels received a patent recently.

Its inventors, Hiram G. Slottow of Baltimore, Md., and Turner L. Smith of Havre de Grace, Md., assigned patent rights to the government as represented by the Secretary of the Army. The device, they claim, combines the excellent dynamic properties of a mechanical spring scale and the accuracy of a beam balance, the two instruments previously used for such wind tunnel measurements.

The new instrument can detect forces up to 40 pounds at a "stiffness" of over 100,000 pounds per square inch. The forces are measured by the electric current generated in the system, such current being proportional to the velocity and displacement of a shaft. The device was awarded patent number 2,685,200.

New Peanut Product

➤ A NEW peanut product, a wafer or chip that can be made by the housewife at home or manufactured in quantity, received patent number 2,685,519.

Harold W. Moore of Concord, Calif., says that his product can be made by adding about six ounces of water to one pound of ground raw peanuts to form a dough. A mill of the type ordinarily used to grind cornmeal is satisfactory for grinding the peanuts. The dough is kneaded to uniform consistency, then extruded in strips through a cookie press or rolled into strips, and cut into convenient size.

The pieces can be either baked in an oven at 200 degrees for about an hour, or fried in deep fat for a few seconds. The chips can be salted after cooking.

A product made in this way, Mr. Moore says, has an attractive appearance and feel, yet it retains substantially the same taste as roasted salted peanuts.

Book Condensations

SUCCESSFUL COMMERCIAL CHEMICAL DEVELOPMENT—H. M. Corley, Ed.—*Wiley*, 374 p., illus., $7.75. This book was authorized and sponsored by the Commercial Chemical Development Association to document the important principles in selecting promising new chemicals and developing them to the stage of economic importance.

THE DISCOVERY OF UNICELLULAR LIFE: Excerpts From Communications by Antoni Van Leeuwenhook to the Royal Society of London—Foreword by A. J. Kluyver—*Chronica Botanica*, 15 p., paper, free upon request direct to publisher, Waltham 54, Mass. This small keepsake was prepared to mark the opening of Professor Waksman's new Institute for Microbiology at Rutgers University.

INDUCTION AND ANALOGY IN MATHEMATICS: Volume I of Mathematics and Plausible Reasoning—G. Polya—*Princeton University Press*, 280 p., illus., $5.50; both volumes $9.00. The creative mathematician, says the author, is a good guesser first and a good proover afterward. This first volume is devoted to intelligent guessing.

PATTERNS OF PLAUSIBLE INFERENCE: Volume II of Mathematics and Plausible Reasoning—G. Polya—*Princeton University Press*, 190 p., $4.50, both volumes $9.00. This volume adds to the material included in Volume I, but is not dependent upon it.

FROM CLASSICAL TO MODERN CHEMISTRY: Some Historical Sketches—A. J. Berry—*Cambridge University Press*, 251 p., $4.75. Although intended for the "serious student" the treatment is nevertheless elementary.

EMPLOYMENT OPPORTUNITIES FOR WOMEN IN PROFESSIONAL ENGINEERING—Lillian V. Inke—*Govt. Printing Office*, Women's Bureau Bulletin No. 254, 38 p., illus., paper, 20 cents.

ISOTOPIC GAS ANALYSIS FOR BIOCHEMISTS—R. F. Glascock—*Academic*, 247 p., illus., $5.80. A manual for practical use in the laboratory in connection with the new techniques utilizing radioactive isotopes.

THE MATHEMATICAL PRACTITIONERS OF TUDOR AND STUART ENGLAND—E. G. R. Taylor—*Cambridge University Press*, 443 p., illus., $9.50. Devoted to those lesser devoted men whose work created the climate in which great scientific advances were made possible.

LABORATORY MANUAL OF CHEMISTRY—Joseph I. Routh—*Saunders*, 3d ed., 109 p., illus., paper, $1.75. A new section of experiments on radioactivity has been included in this edition.

QUALITATIVE ANALYSIS AND CHEMICAL EQUILIBRIUM—T. R. Hogness and Waren C. Johnson—*Holt*, 4th ed., 621 p., illus., $5.00. This edition is intended as a first step toward the integration of qualitative analysis with general chemistry.

SCIENTIFIC INSTRUMENTS YOU CAN MAKE—Helen Miles Davis, Ed.—*Science Service*, 96 p., illus., $2.00. Descriptions written by winners and honorable mentions of recent Science Talent Searches plus descriptions of some famous instruments, written when their noted authors were young experimenters.

Proudly Presented

➤ THE "PROSPECTOR" is a new Geiger counter which employs a patented printed circuit. It is built of miniaturized components, weighs only 2¾ lbs., and has a handle with comfortable grip, which also permits the instrument to be hooked onto a belt. It detects beta and gamma rays, and was developed for ore prospecting. Write, asking about Model GC-238, to the Radiac Co., Inc., 489 Fifth Avenue, New York 17, N. Y.

➤ A CONVERSION CHART for plastics manufacturers uses the slide-rule principle to show at a glance the amounts of resin and accelerator required to produce a cast phenolic part of any size. Other parts of the chart give other useful information. Copies of the chart, as well as technical information and production samples for specific applications are available on request to the offices of the Marblette Corp., 37-21 Thirtieth St., Long Island City 1, N. Y.

➤ A COLOR MEMORY for control chemists in the paint, food, textile, paper, plastics, linoleum, printing and ceramics industries is described in the 8-page illustrated bulletin FS-246 published by the Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, or 904 St. James St., Montreal 3.

➤ SUBMINIATURE glass germanium diodes which combine small size with outstanding characteristics are described in Bulletin TE1319 of the Transitron Electronic Corporation, Dept. SN, 403 Main St., Melrose, Mass.

➤ SILICA SOOT, suggested as a reinforcing filler for synthetic rubbers and plastics, a flatting agent and extender for protective coatings, a thickener for lubricating greases and an additive in textile finishing, is produced by Dow Corning. It is made by burning silicon tetrachloride in the presence of combustible gases. Free samples and literature are available on request to Dow Corning Corp., Midland, Mich.

➤ EBERT Mercury Plunger Relays are completely enclosed, permitting dependable, safe operation under all conditions, as they are unaffected by dirt, dust, heat, moisture, corrosive or explosive atmosphere. Coils are obtainable in a variety of control voltages. Other Ebert Relays are available in one, two and three pole models for loads up to 60 amperes. For complete catalog and further information write Ebert Electronics Corp., 212-25Q Jamaica Ave., Queens Village 28, N. Y.

➤ FIVE NEW weather instruments were introduced this year for home, auto, and amateur weather station owners. Thermometers, barometers and humidity indicators for every taste are manufactured in fashionable designs by the Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.

➤ CURRENT and voltage can be measured and recorded simultaneously on different parts of the same chart by the new Bristol Dynamaster Electronic Potentiometer. Different gears for adjusting chart speeds are available. The instrument is adaptable for telemetering. For additional information write The Bristol Co., Waterbury 29, Conn.

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